# Proceedings of the 15th European Conference on e-Learning ECEL 2016

**Charles University, Prague, Czech Republic**
**27-28 October 2016**

**Edited by**
**Professor Jarmila Novotná**
**and**
**Dr Antonín Jančařík**

Review Process

Papers submitted to this conference have been double-blind peer reviewed before final acceptance to the conference. Initially, abstracts were reviewed for relevance and accessibility and successful authors were invited to submit full papers. Many thanks to the reviewers who helped ensure the quality of all the submissions.

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## Contents

## Preface

These Proceedings represent the work of contributors to the 15th European Conference on e-Learning, ECEL 2016, hosted this year by the Charles University, Prague, Czech Republic on 27-28 October. The Conference Chair is Professor Jarmila Novotná and the Programme Co-Chair is Dr Antonín Jančařík.

The conference will be opened with a keynote address by Stanislav Štech from Charles University on the topic of *Opportunities and Threats in Introducing Educational ICT for Cognitive and Personal Development of Students*. Johan van Niekerk, from the Nelson Mandela Metropolitan University, South Africa will address the topic of *the use of Brain-Compatible Learning in an e-Learning Environment*. On the second day the keynote will be delivered by Michèle Artigue, Ecole Normale Supérieure, Paris, France on the topic *Mathematics Education in the Digital Era*.

ECEL provides a valuable platform for individuals to present their research findings, display their work in progress and discuss conceptual advances in many different branches of e-Learning. At the same time, it provides an important opportunity for members of the EL community to come together with peers, share knowledge and exchange ideas.

With an initial submission of 190 abstracts, after the double blind, peer review process there are 90 academic papers, 5 Phd Papers, 5 Work in Progress papers and 1 non academic paper in these Conference Proceedings. These papers reflect the truly global nature of research in the area with contributions from some 35 countries, including Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Czech Republic, Denmark, Finland, Greece, Hong Kong, Iran, Ireland, Italy, Japan, Lithuania, Malaysia, New Zealand, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, Slovakia, South Africa, Spain, Sweden, Thailand, Tunisia, Turkey, United Arab Emirates, UK and USA.

A selection of papers – those agreed by a panel of reviewers and the editor will be considered for development and publication in the EJEL (Electronic Journal of e-Learning www.ejel.org ).

We wish you a most interesting conference.

Jarmila Novotná and Antonin Jančařík
October 2016

## Conference Committee

**Conference Executive**

**Jarmila Novotná**, Faculty of Education, Charles University, Prague, Czech Republic
**Antonín Jančařík**, Faculty of Education, Charles University, Prague, Czech Republic
**Miroslava Černochová**, Faculty of Education, Charles University, Prague, Czech Republic
**Jiří Vaníček**, Faculty of Education, University of South Bohemia, Czech Republic

**ECEL Committee Members**

The organisers would like to thank those members of the conference committee who assisted in the double-blind peer review process. A full committee list can be seen here:
http://www.academic-conferences.org/conferences/ecel/ecel-committee/

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## Biographies

**Conference Chair**

**Dr Jarmila Novotná** is a Professor in the Faculty of Education at Charles University, Prague, Czech Republic. She gained her Habilitée à diriger des recherché and her Chercheur titulaire, LACES from the University of Bordeaux 2 Segalen, France, Her main areas of research interests are Didactical conditions for the transformation of students' models of activities when grasping knowledge and skills and how to transfer research results into practice.

**Programme Chair**

**Dr Antonín Jančařík** is a Senior lecturer in the Faculty of Education at Charles University, Prague, Czech Republic. He gained his PhD in Algebra from the Faculty of Mathematics and Physics. His main areas of research interest are in the use of ICT for mathematics education and game theory.

**Keynote Speakers**

**Dr. Michèle Artigue** gained her a Ph.D. in mathematical logic from Ecole Normale Supérieure in Paris. For a significant amount of her academic career she has been attached to the Mathematics Department at the University Paris 7, where she is now Emeritus Professor. Her main research interests are the didactics of Calculus and Analysis and the integration of computer technologies into mathematics education. She has supervised more than 20 PhD students and has held many editorial and scientific responsibilities at national and international level. Between 1998 and 2006 she was Vice-President of the International Commission on Mathematical Instruction (ICMI). She was awarded the Felix Klein ICMI Award in 2013 for her lifelong research achievement and the Luis Santalo Medal in 2014 for her contribution to the development of mathematics education in Latin America.

**Professor Johan van Niekerk** is a member of faculty at the School of ICT at the Nelson Mandela Metropolitan University in South Africa. He holds a PhD in Information Technology and has Master's degrees in both Information Technology and Education. His research interests include Brain-compatible Education, E-learning, Cyber Security, Cyber Security Education, Computer Game Design, and Artificial Intelligence. He is the current South African representative on IFIP TC 3 and is also a member of IFIP WG 11.8 and IFIP WG 11.12. He has more than 60 peer-reviewed research publications.

**Dr Stanislav Štech** is a Professor in Educational Psychology at Charles University Prague, Czech Republic. His interests have developed from sociocultural theory to identifying psychological assumptions, and then to empirical research about learning. Adopting a cultural psychological perspective he has developed an understanding of teaching/learning processes as domain-specific. Stanislavhas held many academic positions around Europe. He has published books, articles and research papers mainly in Czech and in French and serves on a number of journal editorial boards. He gained his PhD in work and management psychology at Charles University in 1984.

**Philip Wilkinson-Blake** has worked in Higher Education for over 25 years and has developed skills in the areas of Information Technology, Electronic Engineering and e-Learning. He currently works for Loughborough University School of Business and Economics, where he leads on the development of strategies to support blended, open and partial distance learning courses.He has worked with FutureLearn on the development of several FutureLearn MOOCs. His specialist areas are instructional design techniques and theories, project management for successful delivery of courses; and methods to migrate traditional face-to-face courses to a blended environment.

**Mini Track Chairs**

**Dr Viktor Fuglík** is an Assistant Professor in the Department of Information Technology and Education, Faculty of Education, Charles University in Prague. He is involved in lectures and seminars for bachelor and master students and for lifelong learning. His research interest are on solving scientific problems in the field of the didactics of ICT. He has published in national and international journals and peer-reviewed proceedings. He is also interested in the area of the e-Portfolio as an instrument to support evaluation and self-assessment.

**Dr Mélanie Ciussi** is Professor of Education and ICT at SKEMA Business School in France. She is also co-responsible for the Programme on creativity and sustainable innovation at SKEMA. She is a researcher at the University of Aix Marseille I (Psychology and Education Sciences) and I3M (Information and Communication Science). Her Phd research focused on networks and communities of practices in virtual learning environments. Other areas of expertise include Mobile Learning and 3D educational simulation games for children, which she worked on for a period of two years as head of this project for the French ministry of research. Mélanie was previously employed by French Riviera Chamber of Commerce where she was responsible for elearning for 5 years. She has consulted on a range of e-Learning issues such as course design, social learning, elearning innovations and training needs assessment with elearning tools. She studied Economics, has a Masters degree in Marketing (1996) and in Training & Multimedia (2002). Before moving into research, she worked for Marks and Spencer for 3 years as Assistant Personnel Manager across Scotland and Belgium.

**Prof Vitor Santos** is an Assistant Professor at NOVA IMS - Universidade Nova de Lisboa and European University, where he teaches courses for Computer Science and Informatics Engineering Degrees. He is part of several international conference scientific committees and he has authored several academic publications. Vitor holds a BSc in Informatics Engineering from Cocite, a

Postgraduate course in Computer Science from Science Faculty of Lisbon University, an M.Sc. in information Systems Science and a DEA from Minho University (UM). He holds a Computer Specialist title from Polytechnic Institutes of Guarda, Castelo Branco and Viseu, and a PhD in Technology Information Systems Science from UM.

**Jana Dlouhá** is a researcher at Charles University Environment Centre, an editor in chief of Envigogika journal, and a vice-president of the international network of higher education institutions Copernicus Alliance. She is concerned with transformative education and educational transformation in the light of sustainable development. Her research interests include digital media, open education resources, social learning and participatory approaches in public dialogue. Jana is involved in national and international networks and projects with other universities, NGOs and other social actors.

**Dr Jiri Dlouhy** graduated from the Czech Technical University and now works at the Charles University Environment Center as head of the Education department. His research interests are in the field of IT technologies and open education resources (in education for sustainable development) from both a theoretical and practical point of view. He is a member of the Steering Board of the Sustainability Council of the Czech government, president of the Czech Society for Sustainable Living, member of the Board of the European Environmental Bureau and member of the European ECO forum Coordination Board.

**Clare Gormley** is a Learning Technologist with the Teaching Enhancement Unit at DCU and has worked in online education for over 16 years. She has an MSc in Applied eLearning and has worked with faculty from software engineering, science, and humanities disciplines to create engaging and pedagogically sound courses for online learners. Her core interests include learning design, educational video, and multimedia scripting/ development. Clare has recently published internationally on the use of wearable camera technology in laboratory-based learning. She also teaches an accredited Online Teaching module at DCU and thoroughly enjoys helping educators explore effective ways of leveraging technology.

**Dr Carmen de Pablos** is a Professor of Business Administration at Rey Juan Carlos University in Madrid, Spain since 1994 and an Instructor at Norwich University since 2012. She is the Academic Director for the Master's Degree and Doctoral program in Business Administration and Entrepreneurship at the Rey Juan Carlos University and is co-director of the Master's Degree in Project Management, SAP-ERP Systems. She specialises in the impact of information technologies on organisational systems. She has chaired Doctoral Dissertations and Projects on the impact of information and communication technologies on organisational performance. She has published many articles in journals and books and has been involved with a number of Doctoral Dissertations and competitive projects. She has also worked as a consultant in the area of IS management at Prima Consulting.

## Contributing Authors

**Athra Alawani** is an IT teacher and currently a PhD scholar from Hamdan Bin Mohamed Smart University (PhD in Educational Leadership). I have bachelor degree in Computer Science and Master of Science in Information System. I have two diplomas in school leadership and educational training. I have Microsoft trainer certificate and Certificate of Achievement in IT teachers' supervision program.

**Paulo Alves** Ph.D. in Technology and Information Systems, University of Minho, Portugal, and Master in Multimedia Technology from the University of Porto, Portugal. Is e-learning coordinator and professor at the Polytechnic Institute of Bragança. The research interests include: e-learning, web development and multimedia.

**Maureen Snow Andrade** is Associate Vice President for Academic Programs at Utah Valley University. Her responsibilities include online learning, assessment, faculty development, curriculum, general education, degree completion, and graduate studies. She is a professor of education. Her professional interests include global higher education, distance learning, self-regulated learning, and the scholarship of teaching and learning.

**Habibollah Asghari** received Bsc. And M.sc. degree in Electronics Engineering from University of Khaje Nasir Toosi, Tehran, Iran. He has also been the director of ICT Research Institute, ACECR, from 2007. He is now a PhD. Candidate in Computer Engineering at the department of ECE, University of Tehran from 2012.

**Anders Avdic** is associate professor in Informatics at Dalarna University. He is also appointed particularly qualified teacher in Higher Education at Örebro University. Anders' research interests are e-Learning, Electronic Government, Knowledge Management and End User Development. He has recently been involved in research projects regarding flipped classroom, formative feedback, and clickers.

**Ema Elena Aveleyra** is a Professor of Mathematics and Physics, Specialist Computer Education. Ema is a Master in Management Education Projects. Associate Professor in Physics and Algebra in the University of Buenos Aires. Director of the Center for Distance Education and the Laboratory of Virtual Learning Environments in the School of Engineering-UBA. Author of several works on educational research and ICT in education.

**Nadia Bahri** is an M2 student in Didactics in English at ISSEFC and UVT. She focuses in developing her career as an English teacher and trainer by covering various aspects of teaching. Her research interest lies in Second Language Acquisition, Curriculum Design and Course Development, C.A.L.L, C.A.L.T and Blended Learning.

**Wendy Barber** is an Assistant Professor and former Director of the B.Ed. Program in the Faculty of Education at the University of Ontario Institute of Technology. She was the recipient of the UOIT Teaching Award of Excellence in 2014 and her teaching focuses on Health and Physical Education, Teacher Development, and Online Pedagogy. She is also a researcher with the EI Lab at UOIT focused on problem-based learning and fully online learning communities.

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**Miloslava Černá** PhD. 1997 Lecturer at the Department of Applied Languages, Faculty of Informatics and Management, University of Hradec Králové, Czech Republic. Publications in the following areas: utilization of social applications in higher education, language portals, usability testing, the other area of professional interest is blended learning: design, motivation, communication and virtual communities in e-courses.

**Felix Chao** works at the Independent Learning Centre of the Chinese University of Hong Kong. He has involved in the teaching of Chinese language subjects at both the undergraduate and postgraduate level. His recent academic and research interests include independent learning, classical Chinese literature and Chinese grammar. He is a reviewer of two academic journals.

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**Rouxelle de Villiers** has facilitation and consulting experience of over 25 years in South Africa and New Zealand. She is experienced in teaching students of all levels – from secondary school level, through undergrad to post graduate and executive students. Her passion is management skills development and her scholarship focusses on andragogy and decision competencies.

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**Pavel Kapoun** works as an assistant professor in the Department of the ICT of Pedagogical Faculty of the University of Ostrava in the Czech Republic. His specialization is an information and media literacy. He engages in using of ICT in education outside the classroom in museums and educational exhibitions.

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**Minna Karukka** holds a M.A. degree in Media and Design Technology and a Bachelor's degree in Engineering. She has over 10 years of experience in working at mobile phone industry and research projects, specializing in user centric design, service design and usability. She is currently working for Oulu University of Applied Sciences as a senior lecturer.

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**Karin Tweddell Levinsen**, Associated Professor, PhD. Research concerns design for teaching and learning that involves IT in various forms and modalities, and emerging educational performance and practice, especially students' digital production. Formal/informal learning contexts, digital literacy, teachers' competences, classroom practice, process management, human agency and material performativity intertwined with design for teaching and learning. Draws on a background as professional developer of digital learning solutions.

**Yvonne Loong** works at the Independent Learning Centre of the Chinese University of Hong Kong. She has been involved in the teaching of applied linguistics subjects at both the MA and BA levels. Her recent academic and research interests include development of e-learning materials for independent learning purpose, vocabulary learning, and English for Academic Purposes.

**Colin Loughlin** is a learning technologist at the University of Surrey. Following experience in industry as a web developer, he went on to teach undergraduate computing while gaining his Fellowship of the Higher Education Academy. His current areas of focus are active learning spaces and digital open badges.

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# An Investigation About the Usage and Impact of Digital Video for Learning

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**Abstract:** The main mission of a good educational system is to reach the attainment of well stated learning outcomes, and ensure learners reach the highest level of knowledge and skills needed for the 21st century. It is commonly agreed that technology is a critical tool enabler towards such ideals. Video, in particular, can be a fundamental instrument of education transformation, if used in a way that promotes creative and collaborative use among teachers, while accommodating different learning styles, increasing engagement and excitement among students. This study aims at exploring the usage of digital videos in teaching and its impact on the learning process, both from teachers' and a learners' perspective. It investigates teachers' beliefs about the use of video in their teaching and learning practices, the difficulties they face, as well as strategies used to improve the use of videos in classroom. As for learners, it looks into their satisfaction and motivation to use the recommended videos and the impact on their learning. The research finds that there is a high relationship between the efforts taken by teachers and students' learning, engagement, and overall quality of the classroom experience. The research also sheds light on the need for a web-based video sharing platform that supports the curriculum in UAE public schools, showcasing and appraising best teaching practices in Arabic. Besides, it is highlighted that teachers need solid professional development programs to effectively and pedagogically integrate video technology with curricula as well as skills and knowledge on how to create their own videos suitable for the technological platforms and learning philosophy of current educational systems.

**Keywords:** video technology in education, video sharing platform, ICT in education, impact of videos on learning, teaching and learning process, educational video, web-based video services

## 1. Introduction

In the past several decades, information was created, shared and used by traditional analogy tools such as type writer, phonograph records, films, and typical televisions. Nowadays, the new generation of digital technologies allows for the production and creation of more precise, sharper, better sounding and higher quality content. In addition, with the evolvement of inexpensive and higher performance digital media. we can now easily, quickly, and inexpensively record, edit and share all kinds of digital resources, especially videos.

Video, as a fundamental tool in the process of education transformation, assists in collaboration, accommodates for different learning styles, increases engagement among students, and improves learning outcomes (Greenberg & Zanetis, 2012). The emergence of the web-based video platform leads to existence of millions of videos clips online and covering a wide array of topics uploaded for free distribution to the general public. The main challenge is to determine the usable video resources and how these videos can be effectively used in the instructional processes. In the second decade of the 21st century, the expansion of video technologies in education has been accelerated because of the proliferation of portable devices and smart phones and the existence of the Internet almost everywhere. Moreover, another factor for adoption is the increased understanding and appreciation for these technologies by young people. Recently, most educators recognize video as a powerful technological tool in classroom, which in combination with other instructional strategies and learning resources can play a critical role in modern education.

By reviewing existing research, which discusses the benefits of video in improving learning and the overall quality of the classroom experience, we explore the actual use of digital video among teachers in public schools in UAE to determine its impact on improving high-quality education, learning outcomes, and the development of 21$^{st}$ century skills. This study aims at exploring the usage of digital videos in teaching and its impact on the learning process, both from teachers' and a learners' perspective. It investigates teachers' beliefs about the use of video in their teaching and learning practices, the difficulties they face, as well as strategies used to improve the use of videos in classroom. As for learners, it looks into their satisfaction and motivation to use the recommended videos and the impact on their learning.

## 2. Purpose and significance of the study

The need for technologies in the classroom has increased, which lead to reinforcing teachers' pedagogical beliefs in integrating technologies in teaching practices. Video is one of the first technologies used in classroom; however, there is still a need to look at it as fundamental enabler and complementary tool to obtain high-quality education. This has become a reality, especially, after the emergence of web-based video sharing sites which have led to the availability of huge amount of video segments accessible to everyone and by any devices, covering all areas of life. A significant number of studies (Lang, 2009) measured teachers' use of video, their attitudes and expectations for video impact in learning. They came out with the conclusion that teachers focus mainly on the high value of video as a tool for effective teaching, rather than exploring the wider use of this technology. In the context of the UAE public schools, it is important to understand teachers' viewpoints on the value of video in teaching practices; how teachers can innovate better and its impact on students' learning. It is fundamental to measure the extent to which these beliefs can influence the adoption of using video in the classroom with higher innovative pedagogical measures. It is also important to determine the challenges they may face in selecting proper videos for their subject, creating their own and coming up with novel ideas of use in the classroom or online platforms. Therefore, there is a need to listen to both teachers and students and find out their requirements for better use of videos in the instructional process.

The study provides essential knowledge related to the actual integration of videos in instructional practices in the public schools in UAE. It could be seen as a valuable reference to education stakeholders, policy-makers, and teachers that provide adequate option to encourage the use videos in classroom and eventually increase Arabic educational content on the internet.

As such, this research will answer the following research questions:

- How do UAE teachers use videos in their instructional settings?
- What are their beliefs about the value of integration of videos into their teaching practices?
- What are the various strategies used to improve the educational effectiveness of videos in the teaching and learning process?
- Would new tools and platforms along with new types of support assist in better integration of videos in the teaching and learning process?

## 3. Literature review

### 3.1 Overview of the use of video in education

In the 1950s, educators appreciated the power of audio-visual materials to hook learners' attention and improve their learning experience. This has led to the phenomenal development of both content and technology ever since. The appearance of the digital technology led to newer and ever-greater potentials of flexibility in the delivery of video content. The new generation of digital tools are more precise, better sounding, clearer looking, and have more quality and convenience with greater ability to create, edit and share. The following figure shows the timeline of the visual technologies in the classroom.

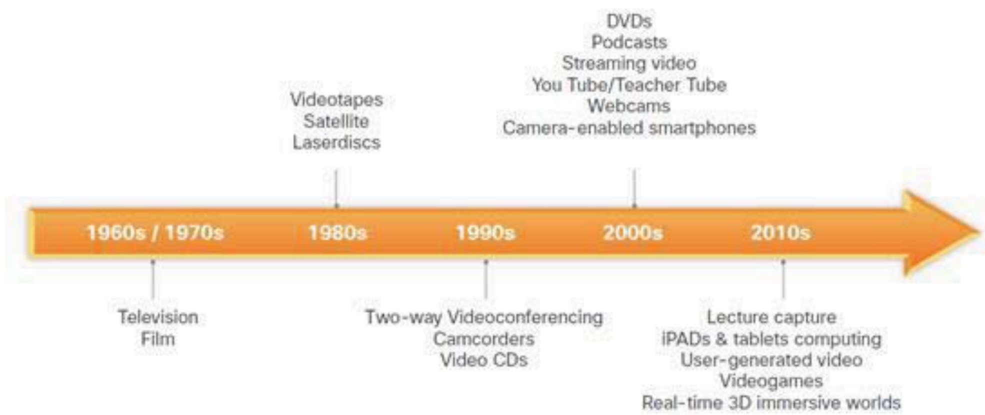


**Figure 1**: Timeline for visual technology in teaching and learning

Video is now recognized by most educators as a powerful ~~communications~~ medium which, in combination with other learning resources and instructional strategies, can perform a vital role in modern education. Horizon Report (2008) noted that digital videos promises widespread adoption among educational institutions in the near future. Hence, the use of instructional videos has increased steadily over the years with two trends (*pedagogical and technological trends)* influencing the shift to rich media content.

Pedagogical trends result from the greater understanding of how people learn, specifically that "one size does not fit all". Students have also moved from passive receivers to active designers of content and learning experience. Technological trends result from the worldwide growth in access to the internet, propagation of video across multiple platforms and video-enabled devices such as smartphones and touch pads introducing a new type of lightweight solution for both educators and learners (Cisco, 2011). Kaufman & Mohan (2009) added that the capturing, editing, and archiving of resources is now in the hands of millions of active practitioners, and the discussion has shifted from terms describing media literacy to "media fluency."

The evolution of video-sharing technologies provides new opportunities to educators. The massive quantity of short video clips delivered through the web has led to the need for studying this emerging phenomenon and evaluating content quality (Snelson, 2008). Many video-sharing sites like YouTube need careful selection of educational content; because most of them cover an array of topics designed for the general public without any quality checks at the moment. Content quality is an important issue to consider when selecting web-based video content. There are numerous high quality online videos for educational use (Lang, 2010), however, some may be inappropriate, of poor quality or inaccurate and this is where educators need to pump their efforts in to assist practising teachers.

The growing trend towards video seems to enhance teachers' beliefs that technology helps them to engage students in learning and do their jobs better. The Public Broadcast Service PBS and Grunwald Association study recorded that teachers primarily turn to the Internet to find, download, and manage digital media (Lang, 2010).

### 3.2 Impact of video on teaching and learning

The following section is the result of exploring existing research to show the benefits of video in enhancing the quality of the classroom practices. It will be useful to share with different education stakeholders as complementary tool for high-quality 21st century education. Thus, there is a need for solid professional development to help teachers integrate video technology within the curricula.

Greenberg & Zanetis (2012) led research on video technologies and their impact on learning outcomes. They came out with the conclusion that pedagogical impact of video is seen in three main concepts: *interactivity with content* by thinking, implementing concepts or note taking, *engagement* by hooking student in most cases, lastly, *knowledge transfer and memory* by storing concepts in their memory longer and better than any other type of instructional media.

Several studies are provided evidence on how video and other multimedia tools can boost the learning experience. Greenberg & Zanetis, (2012) figure of academic performance in the some areas like, noticeable progress in grades and performance, positive effect through letter and number recognition in preschool level, development in students' abilities to collaborate with other and solve problems, and workforce preparation. In addition to the videos' impact in developing the 21st century skills, for example, increase students' motivation to create their own digital material, foster their cross-cultural understanding, enhance their social and emotional skills, and develop their digital and multimedia literacy. Report provided by The University of Queensland (2016) states that the students acquire research skills, problem solving, collaborative working, technology and presentational skills when they create their own videos.

### 3.3 Best practices: How is video best used in the classroom?

Greenberg & Zanetis (2012) emphasize that the incorporation of video technologies in lessons is a process that should be done over a period of time. It requires a clear vision of change in education, ensuring that it goes along with curricula and alternative methodologies, as well as the on-going support of administrators, teachers, learners, and parents.

Many studies have been done to provide an analysis of pedagogical benefits of adopting video as part of teaching and learning especially after the emergence of digital and online video materials. For Karppinen (2005), meaningful learning is active, constructive and individual. It is also collaborative and conversational, contextual and guided. It helps to create an emotional involvement and motivation. Nevertheless, videos make just a single element in the whole classroom activity complex system. Learning results depend mainly on how videos are integrated as part of the general learning environment.

K–12 teachers should think over and over before selecting appropriate films and videos for their lessons. These materials are meant to trigger students' interest, to boost learning, to provide illustration to ideas, concepts and principles, to start discussion, or to develop analysis and critical thinking skills. Significant learning experiences can happen when television, video and other media become part of learning with dynamic and constructive interaction and engagement between students and teachers (Hobbs, 2006). Burden (2007) presents some examples of learning design using digital video in the classroom. The learning design is made up of '**stimulus'** (activities to increase interest and student engagement), '**narrative'** (based on telling stories digitally), '**collaborative'** (interaction between peers when video clips are used to facilitate the acquisition of knowledge), '**conceptual/procedural'** (activities to provide opportunities for students to reinforce what they learn about concepts, ideas and procedures), '**problem based learning'** (the process of students providing solutions to a 'real life' problem or issue presented to them), '**Student authoring'** ( producing a digital product), '**empathy/role-play'** ('Getting to know how others act'), '**research'** , '**media-literacy'**, '**figurative'** (getting the video used as an allegory or metaphor for other purposes). Biechner (cited by Zahn et.el, 2010) argues that students can autonomously create something that seems authentic and meaningful, which gives them the opportunity to experience themselves as competent and motivated learners. Curse (2006) highlighted the important of teaching students how produce their own multimedia objects.

The value of video depends on how it is used in the classroom. To effectively integrate video into the classroom, there should be instruction, preparation and activities before, during and after viewing (Cruse, 2006).Teachers decide on the aim for using video in classroom, then lead a search for the related videos, play content to preview, set up clear purposes behind watching and choose the activities which go with it in the instructional process. CPB (2004) describes the value of video as "highly correlated to its integration within the curriculum—in other words, how closely the content fits into the overall instructional sequence". Moreover, the quality of content is very critical to make educational technology succeed or fail, (Cruse, 2006). Denning (n.d.) states that affective learning and motivation are mostly determined by the choice of media and how successfully it brings enthusiasm and get students engaged in learning activities. He says that some points need to be taken into account when choosing videos for classroom for the purpose of better integration. Those points are: making the presentation varied, giving a sense of humour, narration appropriate to students' age and development of suitable thinking skills, dividing content into understandable smaller parts, organizing sections, Providing meaningful examples, posing open-ended questions, giving students the opportunity to carry out individual thinking are other important suggestions. Video effectiveness decreases, if the choices depend mainly on no-visual elements, and thus benefit from the weakness shown when displaying abstract or non-visual information with total reliance on conveying information in the style of "talking heads" as well as introducing intellectual ideas without support of physical evidence (Hampe, 2006). Despite their importance in learning, videos are often used in non-optimal ways (Hobbs, 2006).

## 4. Methodology

The aim of the study is to explore the usage of digital videos and their impact on the teaching and learning process, both from teachers' and learners' perceptive. It looks into teacher's view about video in their teaching practices, the difficulties they face when looking for relevant videos, as well as their need to improve the use of videos in classroom. As for learners, it looks into their satisfaction and motivation to use the recommended videos and the impact on their learning. This research is exploratory nature, so qualitative methods were chosen as the best methodological approach to this kind of study. The following methods were used to source for data in order to answer the research questions:

- In order to explore the teachers' perspective about the use of videos in learning and its impact, an interview method was used. A total of twelve (12) volunteered teachers from 1123 teachers in Ras Al Khaimah city were involved in the semi-structured interviews. I started by welcoming the participants, acknowledged them for volunteering and appreciated their times. I introduced myself and the purposes of the research. The interviewed teachers cover many subjects' area ( Arabic, English, Math and Science) and they have between 8 to 14 years of experience. The interviews focused on their point of view in three areas: their beliefs and usage of video in teaching practices, search procedure used to find relevant videos and the need for an Arabic educational video sharing platform.

- In order to explore the students' perspectives on the value of video in the learning process, a focus group method was used. It is a suitable method according to the expectation of its effectiveness in producing a large amount of data in a short time and related directly to the research's topic. I conducted two focus groups each consisting of six (6) female students from grade 9, grade 10 and grade 11 in two different schools in Ras Al Khaimah city. The aim of the discussion was to analyze the following areas: students' attitudes towards learning with digital videos, comparing face-to-face learning with learning from videos as well as students' perceptions of effective educational videos.

## 5. Findings

The exploratory analysis found out that teachers and students have positive beliefs about the impact of video on fostering learning, especially if it is accompanied with supportive activities. Nowadays, videos have become one of the most important tools in instructional practices due to the massive quantity of short video clips delivered through the internet. However, many issues related to the selection of the quality and relevant video that matches the learning outcomes with the best integration of these videos in the instructional process have been raised among teachers in UAE public schools. A summary of the main findings is presented below:

- Overall use of videos in classroom

Teachers indicated that the overall average use of videos in their teaching practices is about four times a week. Students noted that their teachers used videos once or twice a day. They usually display videos in the whiteboard by the projector from their personal laptop.

- Beliefs about videos

All the teachers believe that using videos adds greatly to the teaching experience. It helps in explaining complex concepts, saves time, boosts students' knowledge and creativity and raises their level of motivation and engagement. It also breaks up the monotony of lessons and creates a lively humorous atmosphere. Teachers notice that videos make topics interesting, especially if they are made by the students themselves. For them, it is an important tool to help students develop 21st Century skills like collaboration, critical thinking, problem-solving and social interaction.

This common opinion among the teachers is supported by students' strong belief in video usefulness. They say that videos make them understand better, get more engaged, and remember content more quickly. They also feel more motivated to learn and receive knowledge in an exciting way. Students assure that videos enhance their academic achievement if they are directly related to their subjects. Some students search for related videos on their own in order to understand some unclear information they learned in lessons. It is a creative way of self-learning. Students noted that videos have a great impact on the learning process. It conveys information better and faster. Most students search videos in order to look up more information about topics studied at a school; like, experiments, documentaries, arts, and explanations of math rules. They search videos that help them to carry out projects. In addition to that, they search for videos for the purpose of entertainment. They also prefer watching videos to reading information, when they do search for a specific topic. Some students create their own videos.

- Selecting videos for the classroom

Teachers mentioned many criteria they take into account when choosing a video. It should be suitable to learners' age, culture, and background. It should also be related directly to the content of the lesson and the specific objective and provide reliable information from a trusted source. In addition, it should have a reasonable length and clear sound. Teachers, however, noted that they face many difficulties while searching for suitable videos, especially in Arabic. It is time-consuming and needs too much effort to find videos that respond to the lessons requirements. There is a lack of Arabic content and some titles are misleading. Most of the interviewed teachers don't know specialized educational platforms that have reliable content; mainly they search on the YouTube. Finally, titles are not always suitable to content. As for students, they prefer that the videos shown during lessons are made by the teachers. For them, it would be better if these videos are uploaded somewhere on the internet for easy access at any time.

- Lack of Arabic content on the Internet:

All teachers agreed that language is a serious issue with the integration of videos. Arabic teachers say there is good content, but most of it is in local dialects. Science teachers find good content, but most of it is in English. During on the fly translation, students get distracted. They find great difficulty to use videos in English, as most subjects are taught in Arabic in their schools. Some teachers don't even understand the videos themselves, because of the language obstacle.

- Criteria for an effective educational video

Students' opinions were explored about the effective educational video. They believed that in order for a video to be beneficial, some points should be taken into consideration like the high quality of sound and vision and suitable language for topics learned. It should also include featuring characters and visual effects to keep away from dull narration. Moreover, it would be better if it contains true facts and comes from a reliable source, related to the topic of the lesson and does not contradict with their own culture and values.

- Online resources

Teachers mostly rely on open source channels with general content. The majority of teachers use YouTube as their main source of online educational videos. Only two teachers mentioned other channels and website like Discovery Channel, National Geographic, and Ted-ed.com. YouTube is also the main source of videos for the students. They say that they don't know another resource for educational videos.

- Adopting video in classroom

The teachers use videos mostly as a tool for explaining and providing more information, warming up and developing specific skills like cooperative learning, mind mapping and problem solving. They emphasized that using videos in the classroom differs from one subject to another. For example, science teachers use videos to display experiments, which they find difficult to practice in class. Math teachers show videos in problem-solving activities in order to explore rules. Arabic teachers use videos to enrich storytelling, lead a discussion or reinforce a moral value. They also use videos to broadcast interviews with writers or poets. In addition, all teachers use videos as a tool for enrichment. As for English teachers, they often use videos to reinforce the understanding of real life situations by modeling listening and speaking practices.

On the other hand, students think that watching videos should be followed by engaging in enriching activities like mind-maps, worksheets, discussion and collaborative work. They believe that their engagement gets better if videos are in the form of cartoons or stories.

- Problems faced in adopting videos

Students were queried about the problems that frequently occur when their teachers use videos in classrooms. Students state that there are many problems while using videos in lessons. Firstly, language is often unsuitable to the students' level of understanding; because most of the videos are in English and even Arabic videos may use local dialects. Using English videos varies from subject to subject since most of them are in Arabic, so teachers try to translate the video. Adding translation to videos wastes time and distracts students during watching. Secondly, technical issues make students uninterested in the content. Technical issues are often related to slow internet connection, unsupported video formats, low resolution and bad quality of sound and scenes. Thirdly, some videos are so long that students lose attention and get easily bored. Moreover, some videos are not related to the lesson. Finally, they notice the absence of watching videos produced by teachers themselves.

- Lack of teacher produced videos

Half of the interviewed teachers have never produced educational videos. The others said that they made their own videos at least once in their career. Two teachers made videos more than seven times for the year. Students say that they didn't see videos produced by teachers. Meanwhile, there are many videos produced by students as projects. Students are given the chance to show them in the classroom after being checked by teachers.

- Students' production of video

Students believe that their own production of videos leads to the development of various skills such as data collecting, summarizing and inventing their own style of presentation. It gives a deep understanding of topics and high level of learning. In other side, teachers shed lighted on some practices of video presentations produced by some students, which have a positive impact of their self-teem and motivation.

- Need for web-based video sharing platform

All teachers highlighted the need for Arabic educational video platform. It allows them to find relevant content to the subject, contribute to the content, participate in the discussions about videos and mainly share experiences and knowledge about integrated videos in instructional practices. They said that the platform will save time and help them benefit from others' experiences in order to improve their practices. The platform will allow students to enrich their knowledge, encourage them to use Arabic more, and make students understand new concepts more easily, thus overcoming linguistic obstacles.

Concerning teachers' attitude in participating in the video sharing platform, they agreed to take part and contribute to it by creating and editing videos, uploading their own videos, sharing content and experience, commenting and reviewing content and publishing content among students and teachers. Teachers claim that such an ambitious project needs to be promoted; they expect technical and pedagogical support. Technical support is, like, training on video creation, powerful internet infrastructure in schools and availability of video and sound manipulation applications. Pedagogical support could be in training on the best ways to include videos in lessons and examples of integrated videos in classroom practices.

## 6. Discussion

The findings are organized to address the research questions:

Q1: How do UAE teachers use videos in their instructional settings?

Several studies about the use of video in education support the current findings. Greenberg and Zanetis (2012) mention that video enhances the way in which today's learner access, absorb, interpret, process and use information. On the other hand, Hobbs (2006) states that videos are often used in 'suboptimal' ways due to the absence of clear-cut educational objectives and without supportive activities. For better integration of videos in the classroom, Greenberg and Zanetis (2012) requests from education stakeholders to see video technologies as tools needed to be complemented with forward-looking pedagogies. However, the effective usage of the videos in the classroom in the UAE public schools still has some difficulties, like the language, lack of Arabic content on the internet, time-consuming to search for related videos and the technical and pedagogical support needed in order to produce their own videos or integrate them into classroom practices.

Q2: What are their beliefs about the value of integration of videos into their teaching practices?

The findings reveal the positive belief about the benefits of videos in the instructional process from the perspective of teachers and students. Moreover, it is the mandatory trend in any modern educational system due to the technological development, a massive amount of videos online and the popularity of smart devices. Cisco (2011) indicates that the growing trend toward video seems to confirm teachers' beliefs that technology devices help them engage students in learning.

Some of the studies had positive findings of the impact of videos in fostering students' learning. A study carried out by Boster (cited in Cisco, 2010) showed a remarkable rise in math scores for 2500 sixth-graders and eighth-graders in Los Angeles, because students used united streaming digital video on demand. Also in learning English as a second language, video and film present a communicative language within a cultural context (Aiex, cited in Curse, 2006). Other examples include the use of video in history and geography lessons where students can bring a subject to life, stimulate their ability to recall facts and events, and experience places they wouldn't otherwise experience (Cisco, 2011). In science, the use of video for the instruction of science subjects allows students to expand their understanding of complex concepts by strengthening the links between abstract ideas and practical applications.

Q3: What are the various strategies used to improve the educational effectiveness of videos in the teaching and learning process?

Both teachers and students emphasized a set of criteria that must be considered in the selection of the appropriate video to use it in the classroom and the better integration of this video during the classroom, to ensure the effectiveness of videos in teaching and learning. Snelson (2008) confirmed on the content quality of the video when selecting from video-sharing sites. She stated that those sites contain videos of variable quality that have been uploaded by both professionals and amateurs. Teachers stated that the supporting video with associated activity leads to better results on students' learning. That what is clarified by Denning (n.d) in his article "Video in Theory and Practice", where he emphasized on the combining the videos with other learning resources and instructional strategies in order to promote active learning.

Q4: Would new tools and platforms along with new types of support assist in better integration of videos in the teaching and learning process?

There is greater demand for an online stock of videos with Arabic content, supporting the curriculum of the Ministry of Education in UAE. Kaufman and Mohan (2009) in their study about the use of videos in higher education, put emphasis on the demand for online repositories of video to help faculty and library staff to search, find and use video clips on-demand for using in their classes.

Throughout the discussions in this paper, it is noted that teachers are eager to collaborate on enriching the web-based video sharing platform by creating video resources in various subject areas. This platform should be free, accessible by teachers and students and supported by the Ministry of Education. The research recommends starting the project of implementing the video sharing platform in order to provide both teachers and students with video materials related directly to their subjects. It makes up a reliable source of videos. It gives students a chance to revise their subjects in an attractive way. Furthermore, the platform has to contain the technical and pedagogical tutorials related to video production and video usage in classroom practices.

## 7. Recommendations

In order to improve video learning, the following are recommendations:

- To create a specialized educational platform, which serves all subjects, allows content sharing, always opens to updates and supports Arabic content.
- To create special videos and adopt them as part of each subject curriculum.
- To equip schools with the necessary up-to-date devices for video creation like cameras and sound control.
- To share all available videos in a platform, accessible to learners, teachers, and school administrators.
- To enable subject teachers in UAE to use the same platform to co-create video resources especially the availability of editing software in the cloud so that all teachers have access to these tools and software.
- To create new job portfolios for experts in the field of media production to provide support and give training courses to teachers in schools.
- In addition, there is a preference for using live stream videos to share content and lead discussion online.

## 8. Conclusion

There is an opinion that video technology can bring a wide range of multimedia messages into the classroom and can contribute to learning outcomes and students' skills. In sum, the adoption of video technology in the classroom needs a clear vision of the educational system, new professional development programs and new tools like online platforms to make Arabic videos related to the curriculum at both teachers' and students' fingertips. Using videos in the classroom needs to be combined with supportive activities to engage students in learning in a motivating environment. Thus, there is need to share best practices among teachers. They can, for instance, exchange success stories and video recordings. All could be done in one place, a well-elaborated online platform. Although videos are just one element in the intricacy of a classroom activity procedure, they prove to be a necessary part of present and future learning approaches.

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# Relational Reasoning: an Educational Experiment Promoting Digital Diagrammatic Thinking

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**Abstract:** This paper reports on an educational experiment promoting relational reasoning as a form of argumentation with graduate students of ICT in learning. Relational reasoning includes working with mind maps, concept maps, use case diagrams, decision trees, flow diagrams, dialogue maps, situational maps and more. More broadly we can say that relational reasoning consists firstly of using nodes and arcs to represent and overview interrelated meanings as visual networks and secondly allowing the interaction with these networks to generate new dynamic perspectives on the content. The educational experiment consisted of four dedicated lessons introducing different diagramming techniques to students of ICT in learning and supporting them in using these techniques as part of their reasoning and analysis in relation to their semester project. A core example tool was ArcForm that is a general-purpose relational reasoning notation and has been explored as a notational foundation for e-learning systems (Allsopp 2013, 2015). The paper draws a pedagogical insight about the importance of illustrating how tools are useful rather than emphasising their broad usefulness.

**Keywords:** relational reasoning, design/teaching intervention, ArcForm

## 1. Introduction

This paper explores an educational experiment with graduate students of ICT in learning. We aimed to promote relational reasoning, a form of digital diagrammatic thinking using network graph representations comprising nodes and arcs. The program was based on a belief that learning relational reasoning can help students to better analyse complex situations, interpret data and improve the clarity of their arguments and analysis.

Suthers (2001) distinguishes between; 1) *artefacts*, which are the individual representations, 2) *notations*, which are the rules and conventions for a specific type of representation and 3) *tools*, which are the interactive environments that help us to draw and explore a representation. We will refer to the use of both notations and tools as *techniques*. Relational reasoning notations can be further characterised by whether they are cross-domain or domain specific. Cross-domain notations include mind maps (Buzan 1974), concept maps (Novak & Cañas, 2008), dialogue maps (Conklin, 2006) and argument maps (Beardsley 1950). Domain specific notations in for example software design include Universal Modelling Language (UML) notations like use case diagrams and class diagrams (Jacobson, Booch & Rumbaugh, 1998). Many tools have been developed for relational reasoning notations. These include XMind, MindJet, and iMindMap (for mind maps), CMap (for concept mapping), Compendium (for dialogue mapping), Argumentative, Truthmapping.com and Rationale (for argument mapping), and StarUML and UModel by Altova (for UML). While the above mentioned cross-domain notations and their associated tools can be used to explore a breadth of subject matters they are still purpose-specific in that they support a specific process; mind maps support brainstorming or note taking, dialogue maps support facilitation of synchronous discussions and so on. There are also general-purpose graph drawing/layout tools such as Gephi (Bastian, Heymann & Jacomy, 2009) and yEd (Bremer 2007). These can be used for any of the above notations, and for ad hoc notations created for special situations. A technique that we focus on in this paper, ArcForm, can be considered both a cross-domain and a multipurpose notation (Allsopp, 2013).

Aalborg University's internal fund for educational innovations endorsed a program titled "Relational Reasoning" to introduce graduate students of ICT in learning to the above techniques. Our approach was to create a course comprising several lessons where the students are trained in notations and their tools. This paper explores the introduction of relational reasoning techniques in a toolbox course format to university students. In order to do that we have conducted a design intervention promoting relational reasoning techniques and explored an envisioned learning trajectory related to motivation for learning the techniques. We use observation from the intervention to further develop this learning trajectory.

### 1.1 Envisioned learning trajectory and theoretical background

Our hope was that learning relational reasoning could help students to better analyse complex situation in their projects, interpret their data and improve the clarity of their arguments thus supporting their semester projects. Our research approach is based on design-based research (DBR) as it has been described in educational research (DBR collective 2003, Ejersbo et al 2008). In the following section we will articulate our theoretical foundation that has informed the intervention and its envisioned learning trajectory.

One of the characteristics of university teaching is that those being taught are usually adults. According to Illeris (2012), adult learning can best be understood by the way it is different from childhood learning; while childhood education often takes place with a high degree of trust to the adult's responsible for the child's learning, adult learning is on the contrary characterized by a higher degree of autonomy and aligned with the needs experienced by the learner (Illeris 2012, 574). Illeris (2012) suggests that adult learning can be described by three concerns or characteristics; 1) meaning as necessary; adults learn what they want to learn and what they think is meaningful for them to learn, 2) responsibility as sparse; adults only take the responsibility of their learning that they are interested in taking, and 3) resources as important; in their learning, adults draw on the resources available to them (Illeris 2012, 575). Seemingly, the circumstances for learning in university settings are quite good, since the adults are enrolled in a program they have chosen themselves, however, a number of factors make it difficult to exploit these seemingly fertile surroundings. Illeris writes (2012) that we cannot necessarily assume that the students' choice of enrolling in an university program is completely free, and that it is highly likely that the students are faced with learning content (for example an obligatory module) which they have not specifically chosen (Ibid., 578).

Other circumstances in our intervention also potentially challenged the students' level of motivation; the course was conducted at a time in the semester were the students had already begun their semester projects. Would students be interested in learning new techniques at a time when pressured by deadlines? How could we organize the program in a way that would support their needs? Our envisioned learning trajectory was that students would be motivated by the cross-domain power of the techniques and the immediate application of the techniques to their own work. The emphasis was therefore to argue for the broad cross-domain applicability of the techniques using examples from different domains to illustrate aspects of the notations. We also assumed that it would be motivating for the students if we organized the program in a way that would allow them to experiment with the tools by applying them on their own projects. Hands-on exercises were therefore an essential element of every lesson. We investigate this envisioned learning trajectory by drawing on video observations of students' work and discussions, observational notes and qualitative student evaluations. Our analysis and discussion especially concentrates on the level and cause of motivation experienced by the students attending the program.

## 2. The program

The program, Relational Reasoning, was conducted as a part of a pedagogical initiative at Aalborg University seeking to incorporate ICT in Problem Based Learning (PBL). We held the program as a voluntary and extracurricular course comprising four lessons of two hours that provided training for graduate students in ICT and Learning at Aalborg University. Each lesson introduced the students to one or more related notations and relevant digital tools for working with the notation. These lessons covered respectively maps for situational analysis, mind maps and concept maps, dialogue and argument maps, and ArcForm. Each lesson comprised introduction lectures, exercises where the students got the opportunity to gain hands on experience with the notation and time for the students to experiment with applying the tools on their own PBL projects. Students started with hand drawn maps, but in cases where these notations were supported by digital tools, the students also received instruction in, and time to use, these. Each lesson had three facilitators (including the lecturers) supporting between six and 12 students who formed groups of two to four. This gave the students ample access to the supervisors during the exercises and project work. Each lesson ended with a class discussion evaluating the notation and tools, and the lesson as a whole. In the following we will describe each of the lessons, paying special attention to the last lesson where ArcForm was introduced to the students.

*Situational Analysis*. In the first lesson we introduced Adele Clark's (2005) Situational Analysis (SA) and specifically focused on the various kinds of maps in Situational Analysis and their potential in respect to processing and visualizing qualitative data. Clark describes SA as a theoretical/methodological approach that provides the researcher with a number of principles to follow in order to visualize and organize empirical data on its own terms. We introduced the three types of maps in SA, namely situational maps, relational maps and social world/arena maps (Clarke 2005). All maps were introduced with examples from the one facilitators Masters thesis, but relational maps are those considered most obviously a relational reasoning tool, because they include arcs between the identified actors. We did not use digital tools specifically designed for relational maps, but encouraged the students to use general-purpose graph drawing tools.

*Mind mapping and concept mapping*. In this lesson we introduced Tony Busan's ideas behind mind mapping, as well as historical precursors to mind maps. We showed and explored a number of mind map examples where some were hand drawn and some were drawn using a digital tool. We asked students to hand draw a mind map relevant to their project and discussed differences between mind maps and concept maps. We described various different mind mapping tools (xMind, MindJet and iMindMap), a concept mapping tool (CMap) and a tool that is not strictly speaking for mind maps or concept maps, but resembles both (TheBrain). The features of xMind were described in greater detail and all of the student groups used this to create maps relevant to their project.

*Dialogue maps and argument maps*. We introduced dialogue maps, as Conklin (2006) does, as an approach to wicked problems (Rittel & Webber, 1973) and social complexity. However we quickly gave the students a taste of dialogue mapping in practice by conducting a mini workshop using the Compendium dialogue mapping tool. The facilitator asked the initial question "What should we vote today?" which was understood by all the students as referring to that day's (December 3, 2015) Danish national election about adopting EU rules on cross-border policing. The facilitator added students' replies as ideas, questions, pros and cons icons pointing to the original question or any other icon already added. Figure 1 shows the resulting dialogue map including the input form one student that suggested that our initial question "What should we vote?" should be considered a question in response to answering yes to a more basic question: "Should we vote?"

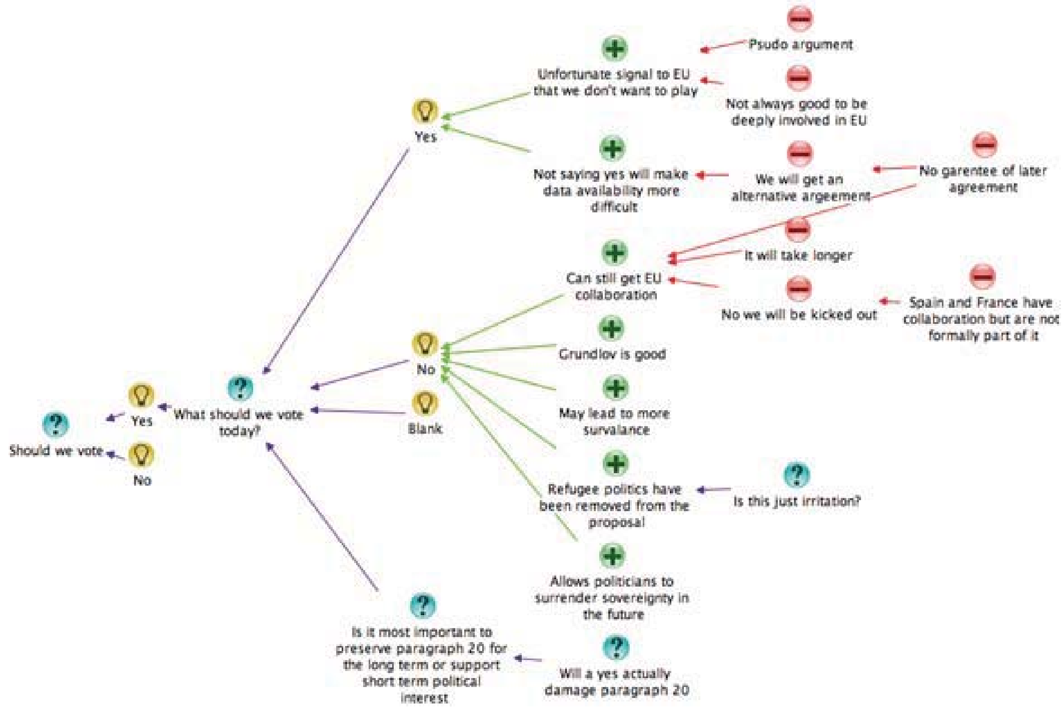


**Figure 1:** A dialogue map created collaboratively in class using Compendium

After using and discussing the students experience in the dialogue mapping workshop we briefly introduced argument mapping (Beardsley 1950) and provided example maps created using the interactive tool at Truthmapping.com. Here we worked backwards from a conclusion to sub conclusions in a tree structure all the way to the constituent assumptions. After this student groups choose between creating a dialogue map or an argument map relevant for their own project.

In the final lesson we wanted to show relational reasoning from a more general-purpose perspective where specific notations are created on an ad hoc basis to show specific types of relationships. This is not easy to teach and requires students to be inventive. We thought we could pull them in the right direction by introducing them to ArcForm – a new notation which combines an extension of general principles of graph based representation with an approach to labelling arcs and nodes allowing diverse natural language sentences to be read from the network.

## 2.1 Introducing ArcForm

ArcForm has been described in Allsopp (2013 and 2015). Allsopp (2013) includes a chapter describing observations of individuals using the notation, but no published research describes it being introduced to a class. In the lesson students received a formal description of ArcForm as a nonlinear, visual form of simple English to support improved collaborative thinking. They were immediately shown an example of an ArcForm map as shown in Figure 1 and heard as a number of sentences were read from the map. Figure 1 is a modification of a map shown in Allsopp (2015) updated to reflect changes in the way that object descriptions are shown.

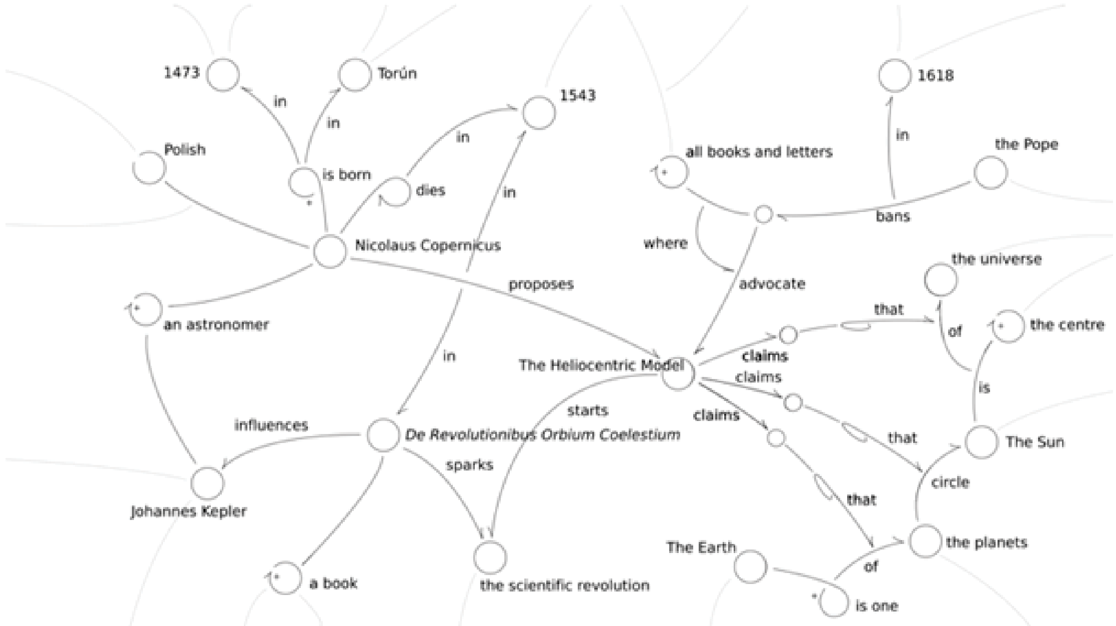


**Figure 2:** An ArcForm map presented in class

The students received an introduction to the different types of tokens used in ArcForm maps: the node, the label, the join arc, the semi arc and the arc rolled up to resemble a node or semi arc. They were shown how arcs could recursively point from or to other arcs and how grammatically normal sentences are explicitly captured in the structure as described at http://arcform.org. The students were shown how objects are represented by nodes and can have labels (possibly more than one label) with proper nouns, object descriptions or properties. Simple sentences were shown with join arcs or semi arcs and labelled respectively with transitive verbs and intransitive verbs. Arcs labelled with prepositions, adverbs, or subordinating conjunctions were shown pointing from simple sentence arcs to create more complex sentences. The students were also shown how complex object descriptions could also be represented as arcs connecting nodes or other arcs.

The students were introduced to the concept of unitokenality (Allsopp 2013), where every meaning can be represented by a single token without duplication. In ArcForm we point arcs from or to that single token whenever we want to use that meaning in other meanings. ArcForm is not currently supported by a user friendly digital tool, but we showed how equating a token in one map with a token in another map will make it possible to merge maps. And because ArcForm expressions can be stored in a simple data scheme we will be able to integrate massive amounts of information into a single dynamically drawn network of meaning crossing subject boundaries. We explained how filtering and laying out that network will support the dynamic and ad hoc creation of new perspectives on existing knowledge.

One of the facilitators described a research project (Tamborg, Misfeldt and Fougt, 2015) where a teacher training program was evaluated. The researchers identified many diverging expectations between different actors and the different *logics* (Nielsen 2012) that influenced their thinking. At first these relationships were mapped using relational maps as described above, before they were mapped in an ArcForm map. The students were asked to compare the two maps. Finally the students were given step by step instructions in translating English sentences to ArcForm, before they were asked to capture aspects of their own work in ArcForm.

## 3. Findings

The authors used three approaches to evaluating the program's usefulness for the students. 1) We collected students' own comments on the notations. We were three facilitators in each lesson and therefore able to take notes as students voiced their thoughts. Unsolicited comments were of particular interest, but the facilitators repeatedly asked the students to share their thoughts on different aspects of the techniques. The students were asked questions like: How they could use the techniques in their own project? If, and how did they think they would add value? And what, if anything did they find challenging? Perhaps due to the small class size the students were very active in giving feedback. 2) We also observed as the students used the notations to map aspects of their PBL project that they were working on. This involved the facilitators moving between groups of students, answering questions when necessary, but otherwise taking notes on technique specific issues being discussed. 3) Finally, when the students submitted their semester project reports, we registered their use of the techniques in the projects. Although this approach added a quantitative aspect to our data collection, it has not played a central part in assessing the program. Some reports included one or more diagrams from the program, but the number of students participating was not considered sufficient to support confident claims about their perceived value. Furthermore the program took place near the end of the project period, and possibly too late for the students to take full advantage of the techniques.

Our findings from student's comments and our observations of students using the notations are diverse, but grouped according to whether they pertain to the special purpose notations or whether they pertain to ArcForm. The finding from the former can be summarized briefly. The participating students considered the lessons relevant. They articulated how they saw the individual techniques were useful. Their explanations reflected what had been explained in the introduction, but were sufficiently rephrased to suggest some independent understanding. They could use the techniques to explore their own projects. This was seen in every lesson as groups of students quickly began to map issues. There were many discussions about how to express ideas in the notations or use the relevant software, but there were equally many discussions suggesting that the actual ideas in their project were being considered deeply or even getting revised in the mapping process.

Overall the students showed a high level of engagement in terms of engaging actively in classroom discussions and frequently asking questions to the teachers. Closing comments were all predominantly positive. Here students emphasized generic benefits like "being able to visualize thoughts", "getting an overview of something complex" and "saving time". Also the digital aspect "getting hands on experience with digital tools" was emphasized.

### 3.1 Learning ArcForm

Unlike the special purpose notations, ArcForm was not immediately understood by the students. This was inferred from the students asking a higher number of clarification questions during the earlier part of the presentation. There were questions relating to the versatility of the arcs. Arcs in ArcForm are not unspecified as in mind maps or in relational maps, nor are they restricted to a single type as in dialogue maps and argument maps. It is unclear if these questions were also precipitated by ArcForm's more complex structure with arcs pointing from or to other arcs. There were also questions relating to the nodes. Nodes in ArcForm are more restricted in their meanings than ideas in mind maps, but much less than nodes in dialogue maps that always represent whole sentences and nodes in relational maps that represent actors. There were questions relating to the dual nature of ArcForm as a diagramming form vs. an information integration scheme. The data integration aspect of ArcForm is not seen in the other notations and several students seemed unsure of what this involved.

Despite some confusion about how to use ArcForm, most students expressed appreciation for its potential use as a diagramming tool. This was particularly evident when they compared how a complex situation was presented both in ArcForm and as a relational map. There were several comments suggesting an appreciation for being able to use "ordinary language" in a visual map.

Understanding an ArcForm map and seeing how the notation could be useful, is important, but we also wanted to see if students could express (statements) in ArcForm. Here students experienced two types of difficulties. Initially there were many students who got stuck expressing simple sentences in ArcForm. The most common mistake here was to draw an arc from a node, when it should have been drawn from another arc. This challenge with drawing ArcForm was identified by Allsopp (2013), who recommended explicitly stating that the meaning of an arc is not identified by its label, but by the concatenation of its label with the labels of its source and destination. Thus instead of a specific arc labelled "owns" representing a concept like ownership, it represents for example 'Nike owns Converse'. With the later interpretation it is easier to see this arc as the source of a new arc labelled "from" and representing 'Nike owns Converse from 2003'. After this way of thinking about arcs was clarified, most groups of student groups were able to correctly draw quite long sentences involving several arcs pointing from or to other arcs.

Another type of difficulty came later when students attempted to capture complicated object descriptions like "the first owner of Converse" not as a single label, but as arcs and nodes. Although the students were helped and the rules for doing this were repeated, the students were only in a few situations able to apply the rules to new descriptions. The students seemed frustrated one student expressed that he felt "there is smoke coming out of my ears". Only one student was able to add complex object descriptions to their ArcForm sentences.

Although there was some difficulty using ArcForm, this was not considered insurmountable by the students. One student offered that the difficulty level of learning ArcForm was equivalent to the difficulty of understanding Actor Network Theory. Another student asked how much more there was to the language and was told of the minor details that were left out. To this he answered: "If this is all the grammar we need to learn, it should be doable. It requires a bit of practice, but there are no long descriptions of each element and that helps."

## 4. Discussion

An obvious question to reflect on is: how valued was the program? On the one hand the students responded overwhelmingly positive to all of the lessons, but it was an extra curricular program and we assume that those that attended were already interested to some degree. Because we have evidence that some students experienced that the techniques are helpful we therefore plan to continue the program as another DBR iteration. In this new iteration we will adjust the timing of the program so as to better inform their choices in their PBL projects. It is also interesting to consider that learning new techniques is probably best done well in advance of impending deadlines.

Regardless of the timing, our emphasis on hands on use of the notations in class was highly appreciated and will be continued in a future iteration. A change to content rather the timing of the program would however result from a potentially revised envisioned learning trajectory. In the following section we discuss how some findings specifically relating to ArcForm can inform such a revision.

### 4.1 Revising the envisioned learning trajectory and improving ArcForm introductions

The findings suggest that the students consider ArcForm to be a challenging notation to learn as exemplified in the "smoke coming out his ears" comment. Yet, the students' engagement in learning ArcForm is characterized by persistence, effort and the willingness to overcome the challenges they are confronted by. As mentioned earlier, our envisioned learning trajectory was informed by literature suggesting that adults learn what they want to learn and what is meaningful for them to learn. We believed that the cross-domain applicability of a notation would be motivating for the students. However, as a student's comment below illustrates, it was not the demonstration of cross-domain applicability that he experienced as motivating, but rather the insight he experienced in a single use case representing a single domain:

> *"(...)it's pure magic in reducing complexity as in the examples with the logics. The three contradictory logics which were at stake could occur in many collaborations. There are these conflicts of interest, which you can point to and say; well, this is where the dog is buried, so to speak. And when you master it I think it is easy to translate something that is complex. It enables you to look at it from the outside and then go inside and pull something relevant out."*

In the comment the student mentions an example with three logics. In the lesson in which we taught ArcForm we introduced a use case that demonstrated how we had used the notation in our own research. We demonstrated how we applied ArcForm in order to explore and illuminate the multiple expectations arising for a group of teachers in a teacher training program. The use case showed the students how ArcForm worked as a way for us to visualize a network consisting of many actors and complex relations in a way that increased overview and transparency. In overcoming the difficulties associated with learning ArcForm, the student points to the value of a single use case that we jointly explored in the lesson. The student refers to the use case with excitement and as the crucial eye-opener that for him demonstrated that ArcForm is a notation that potentially can help to unravel complex situations.

Our initial envisioned learning trajectory was that the students would be motivated by the cross-domain power of the techniques and the immediate application of the techniques to their own work. Though our empirical evidence is scarce, this student's statement challenges the structure of our initial envisioned learning trajectory that the cross-domain applicability of a notation would be the main factor that motivates students to learn it. This student's statement tells us that it was using ArcForm to explore a specific domain that encouraged him to learn the notation. In a university pedagogical contexts this suggests that perhaps it is more relevant to illustrate *how* tools are useful and not *that* they are useful. The excerpt demonstrates that the student's engagement and motivation for learning ArcForm, in spite of the experienced difficulties, was closely connected to the fact that he experienced it as meaningful. The revision of the learning trajectory, however, should not neglect the direct use case related to the students' semester projects as a motivation for taking on the responsibility of learning ArcForm. We are suggesting a shift of focus from the direct instrumental reasons in terms of the broad usefulness related to learning ArcForm towards spending more time exploring a specific use case. This balance relates to the three aspects of motivation in adult learning, namely that meaning is necessary, that responsibility is sparse, and that resources are important (Illeris 2012). It does so by highlighting that in this case, experienced meaning is not the same as usefulness and that we need to provide rich use cases as resources for the students experienced meaning in order to build motivation.

The revision of the learning trajectory that we develop here is of course first and foremost relevant to ArcForm, since this is the notation under examination. However, the balance between broad usefulness and understanding a specific use case is a general concern that can be used in the revision of the relational reasoning workshops in the future.

## 5. Conclusion

Our results indicate that some time must be spent focusing on a specific domain rather than fleetingly showing many examples from different domains. Exploring the opportunities that arise out of one use case can provide the necessary motivation to learn the more difficult notations. This revises our envisioned learning trajectory to connect student motivation in learning relational reasoning techniques to experienced meaning with concrete (domain specific) examples. It remains to be seen in future iterations if and how students benefit from learning the various techniques. Will they use them in their semester projects and can they help them to better analyse complex situations, interpret data and improve the clarity of their arguments?

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# Possibilities and Barriers for e-Learning in Primary School in Denmark

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**Abstract:** How much are we using e-learning in primary school in Denmark? What are the barriers? What are the benefits? Why do we not use e-learning even more? These questions have been the focus for a one year national investigation conducted by ATV, The Danish Academy of Technical Sciences. The investigation included interviews with Danish researchers, persons from the ministry, teachers, students, and e-learning companies. The overall purpose was to make recommendations on how to accelerate the digital transformation of the Danish primary and high schools education system. In this paper, we combine some of the preliminary findings from the interviews with answers to a small questionnaire sent out to 19 Danish e-learning companies. We also add our own observations and visions for how e-learning could be used and which potentials we see for the near future. One major observation is that generally the attitudes to e-learning is positive: Denmark has political goals about access to machines, infrastructure, and internet at every school. There is dedicated substantial funding for schools buying e-learning material, and local successful e-learning companies such as Area9, EduLab, and Clio Online with international footprint and covering 90% of all schools in Denmark. Despite the many positive factors, which contribute to accelerating the use of e-learning, we also found others, which slow down the transformation: Lack of evidence of the benefits from e-learning tools, doubt about whether it is possible to gather evidence in learning, and higher demands for evidence for e-learning tools than for other educational tools. There is also a missing trust and missing communication among stakeholders. We also observed a lack of vision on how digitalization can go beyond "PDFing" a book, and, finally, we met a fear that using Big Data for personalization of the teaching/learning process will be used to stereotype education, or will only be used to save costs.

**Keywords**: e-learning, primary school, national investigation, stakeholders, evidence, barriers

## 1. Introduction

In this paper, we present a view on the digital transformation of the learning sector in Denmark seen from an IT-sector perspective. The IT-sector has over the last decades witnessed the digital transformation of many sectors, and we have seen and have learnt that some challenges are generic across the different sectors.

In the beginning of the digitalization process of a new sector people involved often see many barriers and try to resist the transformation. Part of the reason is that it is a very complicated process. A new value chain has to be formed, products have to be created and sold, old companies disappear, and new (often IT) companies take over. Even if the digital transformation is able to change a sector dramatically, the start of the transformation can be slow and will often be met with skepticism and demand of evidence of the benefits beyond the normal standards. However, when the sector has been digitalized (as e.g. is the case for navigation, writing, emailing, banks, camera, media, phones) the many benefits of IT pops up and only few people wish to roll time back to before IT. This is mainly because you can do much more with IT than you could not do before – e.g. with the camera in your cellphone you cannot only take pictures, but you can directly edit, color and publish the pictures.

The Danish Academy of Technical Sciences (ATV) has appointed a group called "The digital wise men (and women) council" to help accelerate the digitalization in Denmark. The council is independent and autonomous, and consists of digitalization experts from industry and universities. The assumption is that the people in the council has a lot of experience from the last decades of digitalization of several sectors which can help addressing the same problem patterns which pop up again and again.

One of the current focuses for the council is to come up with recommendations on how to accelerate the process of digitalization of the learning sector. To ensure the quality of the recommendations and the likelihood of the recommendations being adopted an almost full 360-degree national stakeholder investigation was conducted.

The investigation included interviews with a very broad set of stakeholders including Danish researchers, persons from the ministry, teachers, students, principal organizations, and e-learning companies. In the section "Methods", we give more information about how the investigation was carried out.

In this paper, we present the results from the investigation, and from a small questionnaire conducted by the authors, and our preliminary recommendations. Based on the broadly anchored investigation, we hope the recommendations even if they are made in a Danish context can be useful and adapted to other countries too.

## 2. Background

Denmark has a population of around 5.7 million people. Approximately 670 thousands are students in primary schools, out of which 540 thousands attend public schools. We have approx. 1300 public primary schools and 550 primary private schools, and in addition various kind of special schools, in total approximately 2500 primary schools. See "Danish Schools (2016)" for more information.

As a part of the Danish national digitalization strategy funding has been reserved to promote use of IT and e-learning in primary schools. In 2015 14 million Euro were used to support development of e-learning tools and as funding for buying such tools. See "National Fund (2016)" for more information.

National and Nordic suppliers of e-learning tools dominate the Danish market. Some of the Danish suppliers have had international success, as e.g. Area9 whose solution was bought by McGraw-Hill and now is widely used in the US. See "Area 9 (2014)".

Most of the e-learning tools developed so far are of what could be called first generation. By that, we mean tools, which in principle do the same as what could be done without a computer - but in a faster, easier, cheaper, smarter or more elegant way. Examples are a book transformed into an e-book, or a tool for writing the result of a mathematical problem on a computer screen instead of using pen and paper. Examples of second generation tools, which is starting to appear right now, are adaptive tools aiming at adjusting to the level of the individual student, see "Waters (2014)", and games which can be played by groups of students. Further example is tools for peer grading.

In the Danish teaching tradition there has been much focus on the top of the pyramid in Bloom's taxonomy "creating, evaluating and analyzing" (see "Bloom et al, 1956"), and on group work. Many first generation e-learning tools instead focus on the bottom of the pyramid "knowledge, remembering, understanding, describing" and most of the time the work is done individually and not in groups. First generation e-learning tools could therefore be viewed as a threat to core values of the Danish school tradition. On the other hand, Denmark has a national strategy promoting e-learning, as discussed above. It sums up to a complex picture where we sometimes take 2 steps forward and 1 step backward in the digitalization process. To secure "Danish" values and tradition in education it is important to put more effort into developing advanced e-learning tools and securing that also second generation e-learning tools are produced in Denmark.

## 3. Methods

We invited companies, which produce digital learning material to answer a short questionnaire. The companies were MaCom, Bookbites, Redia a/s, Systematic, KMD, Labster, EduKarma, Restudy, Gyldendal, EdCom, EduLab, Clio Online, Area9, Alinea, Skoledu, Uniwise, BuildAWorld, Meloni, and EasyCorrect. A few of these companies focus on assisting teachers, but for most, the focus is on providing e-learning material to students. Out of the 19 companies, we got answers from 15. The companies were asked nine questions. These were (translated from Danish):

- How many schools use your solution/product?
- How many users do you have per day, month, and year?
- How much time does a user use on your solution/product?
- What proportion of your users are living in Denmark?
- What is the biggest challenge for getting more schools to use your solution/product?
- What has had the greatest impact on your success?

- Is your solution produced in collaboration with teachers?
- What subjects and grade levels are using your solution/product?
- Anything else we should know about the situation in Denmark regarding e-learning materials?

The answers were very inhomogeneous ranging from a few lines to a very detailed description.

A one year national investigation was conducted by ATV in 2015/16. The work was in practice done by the digital wise men council - see "ATV (2016)". The authors of this paper are elected members of the council. The project consisted of literature studies and stakeholder meetings/interviews with a variety of actors, ranging from suppliers of IT systems to decision makers and users of digital learning resources. The project culminated in a roundtable meeting on 26 January 2016. The meeting was among other things used to stress test the preliminary observations of the council. The roundtable was characterized by very lively and engaged discussion. It was obvious that this meeting played an important role in bringing together key players with strong positions and interests in the area.

The information from interviews, questionnaire, and roundtable meeting has been aggregated and summarized in the sections "Results from the questionnaire" and "Results from the stakeholders - Findings and recommendations".

## 4. Results from the questionnaire

Answers from seven companies (among the largest with respect to impact) on the questionnaire posted to different Danish companies/suppliers providing e-learning tools can be viewed in the table below. The rest of the provided numbers are confidential and are therefore not included in the table.

| Supplier | EduLab | Clio Online | EasyCorrect | MaCom |
|---|---|---|---|---|
| No. of schools | 1600 | 2200 | 100 | E.g. 90% of ordinary high schools. In total 200 |
| No. of users | 50.000 login per day | 4M login per month | 2000 teachers | 10M pages shown per day |
| Grade | Primary school | Primary school | High school | High school |
| Time used | 10 minutes per login. 1.2M questions per day | 7 minutes per login. | | |

| Supplier | Gyldendal | Alinea | Restudy |
|---|---|---|---|
| No. of schools | | | 550 |
| No. of users | 50.000 login per day | 1/10 of all students per day | |
| Grade | Primary school | Primary School | Primary and high schools |
| Time used | 25 pages per unique user per month | | |

Even if our questionnaire investigation is limited, it nevertheless still shows that many students have access to at least one e-learning tool, which they use rather frequently. Some companies have guessed that 45% of the Danish market for teaching material consists of digital teaching material. A survey conducted by one of the larger suppliers says that 8% of all the Danish teachers use only digital teaching material and that <1% do not use digital teaching material at all.

## 5. Results from the stakeholders: Findings and recommendations

In this section, we list some of our main findings from the interviews, questionnaire, and discussions with the stakeholders. Each finding is followed by our recommendations.

### 5.1 Lack of communication between the stakeholders

At the end of the stakeholder investigation, we organized a roundtable discussion having invited most of the stakeholders. All the stakeholders knew of each other, but many met face-to-face for the first time. This should be seen in the light of Denmark being a small country with respect to both geographical distance and number of people. The stakeholders clearly had different opinions, interests and concerns, as e.g. "IT will be used to reduce cost", "IT will radically change the role of teachers", "IT will increase the monitoring of “good” and “bad” teachers and schools", and "we lack time for teachers to adapt to the new technology". However, we also found a shared interest in creating the best possible school for the kids. Meeting face-to-face makes it more easy to - for a moment - “forget” defending specific standpoint and interest and engage in a dialogue on how to move forward together. The council plans to establish a permanent network for roundtable discussions in Denmark to continue the dialogue. The purpose is to develop a shared overall picture and a common understanding, so that barriers can be tackled with a shared strategy. There already exist a number of networks, conferences and committees for some of the stakeholders but the existing networks, conferences and committees do not appear to be able to assemble a sufficiently broad range of stakeholders. The reason for this is maybe that these fora are often established for solving specific tasks and not for looking at the general picture.

**Recommendations:** Roundtable discussions with approx. 15 participants in dialogue including decision makers from for example suppliers and developers of learning resources, ministries, regional and local teacher networks, the Union of Teachers, principals, parents' organizations and academic should be organized. The roundtable should facilitate holistic thinking and decrease myth making.

### 5.2 Evidence

Many of the stakeholders ask for more evidence and documentation of the effects of e-learning. The evidence we found was mostly provided by the suppliers, and did not met the academic and objective characteristics needed to work as “proof”. The lack of convincing evidence make it harder for venture capitalists to invest, for buyers to buy, and to push the political agenda. The research on e-learning methods in the Danish market has so far mainly been based on pedagogical and didactic approaches and qualitative methods. This makes it hard to summarize and draw convincing conclusions. The knowledge base would therefore benefit from being complemented by more quantitative research methods and approaches, as known e.g. from the medical sector. One report “Effektmåling (2014)” made a large investigation asking teachers in Denmark on their view on Digital teaching tool. The teacher overall reported a positive view on effect of such tools especially with respect to the possibilities of making teaching more differentiated matching the individual student level. It should be emphasized that the report does not measure the real effect – but “only” what the teacher believe is the effect.

That evidence can be constructed for positive effect of e-learning is documented in e.g. “Literature Review on the Impact of Digital Technology on Learning and Teaching (2015)”.

**Recommendations:** With a range of digital learning material applied at Danish schools, it will be possible to get data to form the basis of quantitative analyses. It is important to support quantitative research, done independently of suppliers.

### 5.3 Infrastructure, business, and IT supporting e-learning

Despite increased use of e-learning resources and reduced resistance, there are still many barriers. Internet infrastructures at schools were reported as being unreliable and some teachers believe they need to have a fall back solution ready in case the internet is not working. In a survey 41% answered that "unreliable IT" was one of the main reasons for not using e-learning more often. Suppliers report that they avoid or minimize the use of videos to reduce risk of internet failure. This contrast with reports by the government, which say that the goal of good infrastructures has been achieved.

From a business point of view, the stakeholders report that the buyers of teaching material at individual schools have lack of knowledge about e-learning material in general and need more IT skills.

We also saw examples of innovative tools being useful for learning, but not fulfilling the traditional criteria of a learning material. This has the effect that a conservative buying politics can block innovative development of e-learning material.

**Recommendations:** From a technical point of view standardization, e.g. with respect to firewalls, is needed. This is a request explicitly stated by many of the stakeholders to minimize cost for setup. The infrastructure should be upgraded so that internet is a reliable resource - also for videos. Using modern technology as known from Content Delivery Networks (CDN) it should be a realistic goal.

The process for buying teaching materials should be reviewed to ensure that the requirements do not favor static material/books in cases where digital material is better. Education should be given to buyers to equip them with the skills and tools needed to make the best possible choices.

## 5.4 Data: Lack of use and lack of decision on "ownership"

With digital learning material, we gather much information about students' progress and on how the learning material is used. The data can be used to increase personalized and adaptive learning, and to create management tools for decision making in schools. One recent example, a tool described by "Sara et al (2015)", illustrates how drop-out among high school students can be predicted with very high probability using data from study administration systems. The intention with the tool is to ensure that actions are taken before a student drops out. Shortly after the introduction of the tool - at almost all high schools in Denmark – it was pulled out of the market because it was met with reactions like "one should not classify students like that". At almost the same time, the Danish government has taken the decision that schools in Denmark should be much more data driven, like many companies.

Concern about privacy and security is relevant. However, as in any other sector we should still be able to use data, doing it to improve learning. Ideally, data from digital learning tools should be combined with relevant context data from public owned databases. Researchers under regulated work practice should be able to get access to such data as e.g. done in Denmark with health related data. In addition and also under regulation one digital learning tool should be able to have access to data, at least in aggregated form, from another tool. E.g., a tool for math learning could benefit from knowing a student's skill in reading.

This leads to a discussion of who is the owner of the data? The schools (or the state) could be owner of data generated by students using e-learning tools (as users could be owners of own data uploaded to social media). Doing that, schools would have the right to provide the data for research, which maybe also would make it possible to, in a more smooth way, change suppliers of tools etc.

**Recommendations:** Decisions should be taken to make it clear who is the owner of data generated by e-learning tools. Making such a decision should be done very carefully, knowing that insights from data can be developed to be beneficial for the individual students and the whole education sector - weighed against privacy and security concerns.

We also recommend the development of a new code of conduct for dealing with learning data. This should include decisions on how data may be processed, how the data sources are allowed to be interconnected, and how the results should be presented. Such a code should protect teachers and students and ensure ethical handling of data. It could be useful to look to the health world, where handling of sensitive personal data has been done in many years.

## 5.5 Lack of shared terminology

The investigation also uncovered a lack of shared terminology. Persons, who talk about IT in learning, e-learning, or digital learning materials, often mean very different things with these words. Some think about tools for administration of schedules or for planning a lecture. Some mean tools for guiding the students through a learning process or a learning management system, some talk about tools for training or they talk about digital materials such as e-books or videos. Others again talk about games. In addition, the distinction between basic tools (first generation tools) and more advanced tools (second generation tools) is important.

**Recommendations:** Emphasis should be put on developing a classification system for IT based tools for learning and getting it adopted by the stakeholders.

### 5.6 Need of examples showing what is beyond state-of-the-art

There is a need for practical examples on how and if advanced e-learning materials can enhance the learning process dramatically – and a need for thinking 5-10 years ahead. As seen from many other sectors, which have been digitalized, one first start realizing many of the benefits of IT after a while. To search for and present a collection of the most innovative showcases from around the world could benefit the development and implementation in Denmark.

**Recommendations:** Illustrative examples should be collected and shown to a wide range of stakeholders ensuring that the opportunities for learning when learning has been digitalized are known. The aim should be to facilitate a common platform for dialogue, to create an increased demand, and to push the political agenda.

## 6. Conclusion

The main goal when introducing e-learning tools in Danish primary and high school is to ensure that the students develop to their full potential and are as prepared as possible for the many challenges of our future society.

We have seen a positive picture of engagement, a positive approach and good results for the many teachers who embrace the new tools. However, we also see some teachers who do not want to take the new IT technology into their toolbox. It is important to help teachers to transform their didactic practice into a new one that combines the best from the analog and the digital worlds.

We see a number of serious barriers, which have to be broken down before the full potential of e-learning can be achieved. A way to do this is by working together and by facilitating a continuous and serious discussion among the stakeholders. We see a need for quantitative research, done independently of suppliers. This requires that data from the different digital learning materials are made available to researchers, and that we develop a code of conduct for dealing with data from learning materials. To meet the challenges of practical problems in schools it is important to work for standardization of equipment and IT tools, and for increasing the competence level at schools.

It is important to promote collection of good examples on how e-learning can be done in new, innovative, and efficient ways to help the students develop their skills.

We hope that even though this paper is based on Danish experiences that the recommendations can be useful for and adapted to other countries too.

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# Learning Styles and Access to Virtual Learning Environments in the Academic Performance

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**Abstract:** This study focuses on the issue regarding student-centred teaching and learning. Based on the acknowledgement of students' learning styles, we tried to identify indicators which might enable us to relate students' learning styles to academic performance results as well as to the frequency of use of a virtual learning environment (VLE) used by the institution which the sample subjects participating in this study belong to. The research questions guiding this study were as follows: Are there any relations between students' learning styles and the frequency of accesses to the institution's VLE? Are there any relations between students' learning styles and academic performance? Are there any relations between the frequency of accesses to the institution's VLE and students' academic performance results? In order to answer the above research questions, we defined the following aims: identifying the sample subjects' predominant style; assessing the influence of subjects' learning styles on their learning results; assessing the influence of subjects' learning styles on the frequency of access to the institution's VLE; assessing the influence of the frequency of access to the VLE on learning results. This study enabled the identification of learning styles and the search for indicators which may allow the establishment of a relation between the learning styles of a sample of 51 undergraduates from a Portuguese public higher education degree course and their learning results, as well as the frequency of their access to the virtual learning environment (VLE). The data concerning learning results and the frequency of access to the VLE resulted directly from consulting the institution's databases associated with the VLE, whereas the data regarding learning styles was obtained after conducting the Honey-Alonso CHAEA survey, also integrated in the institution's VLE. From the results obtained stands out the fact that the majority of the sample subjects have a predominant reflexive learning style. As well as this, there are a high percentage of undergraduates with higher learning preferences in more than one style. With regard to academic performance, the results show that both the final classifications mean and the mean of the course units in which the students obtained a passing mark were higher among the students with a predominant reflexive learning style. The highest mean of the number of accesses to the VLE was observed among the students with a predominant pragmatist learning style. The correlation between the variables associated with the learning styles and the mean of students' marks is low or very low in all situations. This study may reveal to be of great importance, as it enables the obtainment of indicators which facilitate the understanding of the relation between undergraduates' learning styles and the use of VLEs within a formal teaching and learning context.

**Keywords:** learning styles, virtual learning environments, academic performance

## 1. Introduction

In this paper, emphasis is laid on knowing students by identifying their learning styles, on the technological means supported by a virtual learning environment (VLE) and on the relations between students' learning styles, accesses to VLEs and results of academic performance.

As highlighted by Abidin, Rezaee, Abdullah, and Singh (2011), learning processes vary from person to person due to the presence of biological and psychological differences.

According to Valencia (2014), higher education institutions must focus on undergraduates' ways of learning and on their difficulties to adapt to the demands of higher education. The author admits that it is a challenge for teachers to acknowledge their students' ways of learning, previous knowledge, needs, paces, motivations, expectations and skills.

We assess the existence of relations between the sample subjects' learning styles, learning results and frequency of access to the virtual learning environment of the institution they belong to.

For the identification of the undergraduates' learning styles, we administered the Honey-Alonso learning styles identification questionnaire, Cuestionario Honey-Alonso de Estilos de Aprendizaje (CHAEA). For the identification of the students' frequency of accesses to the institution's VLE, we used access records stored in databases associated with that same VLE. The data collected on the frequency of accesses to the VLE and the performance results concern the first semester of the 2014/2015 academic year, the semester under analysis. The performance results translated into students' marks were obtained from the institution's databases by consulting the final marks records of the sample subjects.

The sample is composed of undergraduates attending the 1st year of a Management degree course of a Portuguese higher education institution. Considering the given sample, we sought for indicators which may contribute to the achievement of the following goals: identify the sample subjects' predominant learning style; assess the influence that each subject's learning style may or not have on their learning results; assess the influence that each subject's learning style may or not have on the frequency of access to the institution's virtual learning environment.

The paper starts with the introduction, followed by the main topics, namely the theoretical framework, methodology, presentation and discussion of results, conclusions and references.

## 2. Theoretical framework

Both the themes of virtual learning environments (VLEs) and learning styles have deserved the attention of numerous researchers, educators and educational institutions. Relating the two and getting the best of each one of them may contribute to the improvement of the teaching and learning process and consequently, the improvement of academic performance. Gašević, Dawson, Rogers and Gasevic (2016) highlight that the association of data regarding students' activity in a VLE with their academic performance is moderated by the teaching conditions.

The European Commission (2014) suggests that the data obtained from the records regarding students' actions in VLEs may show evidence of the way students involve in the course, the way they interact with other students and acquire concepts. It can also provide information on the learning process, allowing the identification of students at risk, thus contributing to the decrease of failure rates.

From a pedagogical perspective, the VLEs used in educational institutions enhance developments and provide new experiences. However, they are mainly targeted towards the production and distribution of contents. The majority of the applications integrated in VLEs were designed focusing on content rather than the learning process (Salinas, 2012). According to this author, these environments replicate traditional teaching by distributing online contents, sending messages and notices, and communicating through discussion forums and chats.

The use of VLEs allows the diversification of teaching and learning strategies since according to Soflano, Connolly and Hainey (2015), the use of one single teaching strategy for all students may have a negative impact on the learning results, namely for students whose way of learning differs from that of most students. When the focus of learning is laid on the student, it is essential to know their predominant learning styles. As highlighted by Zacharis (2011), numerous educators admit that understanding the differences in their students' learning styles is an important aspect for the effectiveness of teaching and learning. Learning styles account for individual differences among people when immersed in a learning process (Moreno & Defude, 2010). One of the most used definitions of learning style is presented by Keefe (1979), who states that learning style can be defined as the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. As a result of different initial experiences and educational levels, students considerably vary in the way they approach learning and consequently, in the way they must be taught (Zacharis, 2011).

As far as ways of learning are concerned, some students learn better interactively and some individually, others focus on facts and data while others are interested in theories and concepts, some prefer visual information while others respond better to written and spoken explanations (Mupinga, Nora, & Yaw, 2006). Some may understand better through images while other prefer texts, some deal well with theories while others deal better with experimentation and examples (Truong, 2016). As highlighted by Zacharis (2011), various learning styles models are being used to assess the way students learn to learn. Among such models, we highlight those of Kolb (1984), Honey and Mumford (1992), Pask (1976), and Felder and Silverman (1988). In this study, we chose the model of Honey and Mumford (1992).

According to El-Bishouty, Chang, Graf, Kinshuk, and Chen (2014), learning styles affect the way each person learns, acts within a learning group, participates in learning activities, relates to others and solves problems.

Within the context of higher education, the acknowledgement of undergraduates' learning styles may help to build environments which provide good conditions for an effective learning (Cornejo & Martín, 2013).

When teachers acknowledge their students' learning styles they can, as educational agents, change, adapt and create educational practices enhancing pedagogical actions which are more coherent according to their students' needs, interests and capacities. Valencia (2014) states that the acknowledgement of students' learning styles contributes to the creation of educational and pedagogical responses which enable teachers to follow and help students to achieve new and pertinent ways of learning in higher education.

## 3. Methodology

The data used in this paper was obtained during the first semester of the 2014/2015 academic year (September 2014 to February 2015), from a sample of 51 undergraduates, 17 of which are male and 34 are female. The age mean is 21, the median is 20 years old and the mode is 19 years old. They are all in the first year of a Management degree course in a Portuguese public higher education institution. The population is of 166 subjects and the sample corresponds to approximately 31% of the population. It is a non-probabilistic convenience sample and was selected within a course where one of the researchers was teaching.

With respect to the aims, this study is exploratory with predominantly descriptive features. It is exploratory because it may be considered a preliminary study aiming to a deep knowledge of the variables under study within the context they are inserted in, and because it enables the obtainment of indicators which may represent starting points for broader studies. It can be considered descriptive because there is no intention of assessing the influence of manipulating independent variables over dependent variables. Hence, the focus of this study lies on the description of findings related to the sample and the variables under study, without any researchers' experimental action.

The nature of the study is quantitative because the variables assume quantitative values and it is possible to study statistical relations between them. Quantitative research enables the testing of the relation between variables and such variables can be measured with instruments which provide numerical data which can be analysed through statistical procedures (Creswell, 2014).

With regard to the data collection procedures, this study can be considered a desk review. The data collection procedures relate to computing procedures of consultation and extraction of information from the databases associated with the VLE adopted by the higher education institution that the students belong to.

Apart from the data regarding the students' gender, degree course and course year, the main data analysed in this study concerns students' learning styles, their number of accesses to the VLE and their academic performance, translated into the final marks obtained in the course units they are enrolled in.

For collecting the data, some ethical principles were born in mind, namely the data confidentiality and the anonymity of the undergraduates involved. As highlighted by Lam, Lo, Lee, and McNaught (2012), the extraction of records from a virtual environment provides relevant information regarding the availability and access to contents and it avoids students and teachers' waste of time with surveys or other data collection techniques to obtain that same information. The use of VLEs which automatically keep records of the students' activities may provide an alternative to the research methodologies using surveys (Black, Dawson & Priem, 2008).

The data regarding the identification of learning styles was obtained through the CHAEA questionnaire, integrated in the VLE. The data regarding the number of accesses to the VLE was automatically recorded in databases and later obtained from those same databases.

## 4. Presentation and discussion of results

### 4.1 Sample subjects' learning styles

In the identification of learning styles, we considered the approach developed by Honey and Mumford (1992), which accounts for four learning styles: activist, reflector, theorist and pragmatist. The identification of the subjects' learning styles was based on the online conduction of the CHAEA questionnaire available in the institution's VLE.

The CHAEA questionnaire is composed of 80 dichotomous items, with 20 items corresponding to each learning style. The answer to each item admits a score of one or zero points, according to the respective higher or lower level of agreement of the subject with the given statement. The score of each subject in each learning style is obtained according to their answers to the CHAEA questionnaire and to the profile defined by Alonso, Galego and Honey (1999) within the context of their learning styles theory.

After obtaining students' scores in each learning style, the data was grouped into five different groups denominated as: activist, reflector, theorist, pragmatist and mixed.

The predominant learning style of each subject was identified according to the style in which they had the highest score. The subject was included in the mixed group when they had two or more scores that were similar and higher than the remaining ones.

Table 1 presents the distribution of the sample subjects among the referred groups of learning styles.

**Table 1**: Subjects' distribution per predominant learning style (n=51)

| **Learning style** | **Students** | |
|---|---|---|
| | n | % |
| Activist | 5 | 9.8 |
| Reflector | 29 | 56.9 |
| Theorist | 3 | 5.9 |
| Pragmatist | 6 | 11.8 |
| Mixed | 8 | 15.7 |

The majority of students showed a higher preference for the reflector learning style. The predominant theorist learning style accounted for the smallest number of students.

Bearing in mind that each student revealed features associated with the four learning styles, we determined the mean, mode, median, minimum and maximum score for the set of scores regarding each style. The distribution of the statistics associated with these scores is presented in Table 2.

**Table 2:** Distribution of scores statistics per learning style (n=51)

| **Learning style** | **Scores per learning style** | | | | |
|---|---|---|---|---|---|
| | Mean | Median | Mode | Minimum | Maximum |
| Activist | 11.8 | 12 | 12 | 6 | 18 |
| Reflector | 15.9 | 16 | 14 | 2 | 20 |
| Theorist | 13.9 | 14 | 15 | 6 | 19 |
| Pragmatist | 13.5 | 13 | 12 | 6 | 19 |

By observing Table 2 we see that the mean of scores varies from learning style to learning style and that the highest (15.9) concerns the reflector style and the lowest (11.8) concerns the activist style. The means of the theorist and the pragmatist style are 13.9 and 13.5, respectively. In a study conducted by Ojeda and Herrera (2013) involving 170 undergraduates of an Engineering degree course, the results showed that the highest average scores were found in the reflector style.

The aims of this study are to find indicators which enable a better understanding of students' way of learning considering their learning styles and to define strategies supported by VLEs which enable the improvement of their academic performance. Therefore, hereafter follows the analysis of the undergraduates' academic performance according to their learning styles.

## 4.2 Learning styles, academic performance and access to the virtual learning environment

After identifying the undergraduates' learning style, some questions arise such as: Does each subject's learning style influence their academic performance? The answer to this question involves various analysis and perspectives as both the individual style and academic performance involve multiple dimensions. However, some dimensions are more easily observable and allow the obtainment of indicators which may help to understand the relations between the subjects' learning styles and their academic performance. Hence, from research conducted on a sample of 317 students, Abidin, Rezaee, Abdullah and Singh (2011) concluded that learning styles have an impact on students' global academic performance, highlighting the importance of acknowledging students' learning styles in order to provide teachers with this knowledge and therefore enable them to provide a more effective learning.

Academic performance is an indicator of learnings which depicts each student in terms of their capacities and abilities as a result of their participation in an educational situation (Valencia, 2014). Another question that also arises is to know whether each subject's learning style influences their frequency of access to the institution's virtual learning environment.

With regard to students' academic performance, we will consider the final marks obtained in the course units they are enrolled in. In order to relate the subjects of each predominant learning style to their final marks, we highlight that the mean of the 51 sample subjects' final marks in the course units was 12 out of twenty, the mean of the course units they passed was 3.2 and the mean of the number of accesses to the institution's VLE was of 145.5 accesses.

Table 3 presents the distribution of statistics regarding the final mark among the categories associated with learning styles.

**Table 3**: Distribution of statistics of final marks per learning style (n=51)

| **Learning style** | **Academic performance (0-20 marking scale)** | | | |
|---|---|---|---|---|
| | Mean | Median | Minimum | Maximum |
| Activist | 12.0 | 12.0 | 10.7 | 13.0 |
| Reflector | 12.1 | 11.8 | 10.0 | 18.4 |
| Theorist | 10.6 | 10.6 | 10.0 | 11.3 |
| Pragmatist | 11.5 | 11.5 | 10.5 | 12.7 |
| Mixed | 11.9 | 11.5 | 10.0 | 14.6 |

The data presented in Table 3 reveals that the statistics associated with the various learning styles are analogous and that the highest mean of marks was observed in the subjects of the reflector style and the lowest mean in the theorist style. Bearing in mind that the mean of marks does not express the number of course units that each student passed, Table 4 presents the distribution of statistics related to the number of course units that students passed.

**Table 4:** Distribution of statistics regarding the course units students passed per learning style (n=51)

| **Learning style** | **Couse units students passed** | | | |
|---|---|---|---|---|
| | Mean | Maximum | Minimum | Median |
| Activist | 3.0 | 4.0 | 2.0 | 3.0 |
| Reflector | 3.6 | 5.0 | 0.0 | 4.0 |
| Theorist | 1.7 | 4.0 | 0.0 | 1.0 |
| Pragmatist | 2.0 | 4.0 | 0.0 | 2.5 |
| Mixed | 3.0 | 5.0 | 0.0 | 3.5 |

What stands out is that the predominantly reflector students are the ones with the highest mean of passed course units while the predominantly theorist students are the ones who present the lowest mean. Except for the activist learning style, all the others reveal that there are students who did not pass any of the course units. It was also found that regarding the course units that students passed, the predominantly reflector students were the ones who passed the biggest number of course units, namely five, which corresponds to the total of course units they were enrolled in. Bearing in mind that virtual learning environments represent current resources of widespread use within educational institutions, especially in higher education institutions, this study also addressed the concern to assess the frequency of access to the VLE according to the undergraduates' learning styles.

Since the data of this research work accounts for one academic semester, we analysed the frequency of access to the VLE during that period of time. In Table 5, we present the distribution of the statistics regarding the frequency of access to the VLE among the sample subjects.

**Table 5**: Distribution of the frequencies of access to the VLE among the learning styles (n=51)

| **Learning style** | **Frequency of access to the VLE** | | | |
|---|---|---|---|---|
| | Mean | Median | Minimum | Maximum |
| Activist | 104.4 | 96.0 | 54.0 | 175.0 |
| Reflector | 156.8 | 132.0 | 12.0 | 329.0 |
| Theorist | 111.0 | 115.0 | 84.0 | 134.0 |
| Pragmatist | 170.3 | 164.5 | 64.0 | 255.0 |
| Mixed | 124.6 | 120.5 | 94.0 | 166.0 |

Considering that the number of subjects differs from learning style to learning style, it is not possible to use statistical tests which are robust enough to ensure whether these differences are significant. As it is not possible to generalise the results, we present some indicators supported by the data displayed in Table 5. Thus, we found that the students with a pragmatist style are the ones who reveal the highest frequency mean of access to the VLE while the students with an activist style reveal the lowest mean. The same is revealed as far as the median is concerned. Also, we found that the reflector style subjects present the largest amplitude regarding the number of accesses, with a minimum of 12 and a maximum of 329 accesses. Bearing in mind that each subject has a score per learning style, it is possible to consider four groups of scores, one for each learning style, as well as the respective means of the sample students' final marks. Therefore, we used Pearson's correlation to assess the level of association between each of the variables (activist, reflector, theorist and pragmatist) and the variable mean of subjects' marks in the course units they passed.

In Table 6, we present Pearson's coefficients of correlation between the variables mentioned, obtained through the statistical program SPSS (Statistical Package for the Social Sciences).

**Table 6:** Level of association between learning styles and the means of marks obtained by students in the course units (Pearson's coefficient of correlation)

| | | **activist** | **reflector** | **theorist** | **pragmatist** |
|---|---|---|---|---|---|
| **activist** | correlation | 1 | -.168 | .078 | .342* |
| | sig. (2-tailed) | | .237 | .586 | .014 |
| **reflector** | correlation | -.168 | 1 | .629** | .176 |
| | sig. (2-tailed) | .237 | | .000 | .217 |
| **theorist** | correlation | .078 | .629** | 1 | .424** |
| | sig. (2-tailed) | .586 | .000 | | .002 |
| **pragmatist** | correlation | .342* | .176 | .424** | 1 |
| | sig. (2-tailed) | ,014 | ,217 | ,002 | |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | |

We considered the coefficient of correlation (δ) and used the classification of correlation proposed by Morais (2000): very low if $\delta \in ]-0.2; 0.2[$; low if $\delta \in (\, ]-0.4; -0.2] \cup [0.2; 0.4[\, )$; moderate if $\delta \in (\, [-0.7; -0.4] \cup [0.4; 0.7]\, )$; high if $\delta \in (\, ]-0.9; 0.7[ \cup ]0.7; 0.9[\, )$; and very high if $\delta \in (\, [-1; -0.9] \cup [0.9; 1]\, )$.

Therefore, the conclusion is that the correlation between the variables associated with each learning style and the mean of marks is significant as far as the activist style is concerned, with a level of significance lower than 0.05, thus a low and negative correlation. Also to be highlighted is the observation of other significant correlations: moderate and positive between the variables theorist and reflector; low and negative between the variables pragmatist and activist; moderate and positive between the variables pragmatist and theorist.

In the light of this, no evidence was found that may suggest that each student's learning styles may influence their learning results.

The acknowledgement of the data presented is not alone sufficient to draw conclusions about the influence that the frequency of access to the VLE may have on the teaching and learning process. However, the indicators of frequency associated with other indicators, namely the tools that students mostly use or the tasks they develop may help researchers, educators and institutions to develop teaching and learning strategies increasingly more adequate to their students' learning styles and consequently, open perspectives to the obtainment of better learning results.

With regard to the tools mostly used and the activities developed by students in the VLE, we highlight a study conducted by Alves, Miranda and Morais (2015), in which the authors studied the accesses to the VLE of a higher education institution by a sample of approximately 7000 students per year, during five years. They concluded that the tools of the VLE mostly used were Resources, Messages and Assignments, and that the activities developed most frequently were consulting information, sending messages and submitting assignments.

We admit that after acknowledging students' predominant learning styles, the frequency of access to the VLE and the actions they develop in the VLE, it is easier to adequate the teaching and learning strategies to their favourite ways of learning and it is easier to provide students with conditions that may enable a better performance.

As highlighted by Gallego and Alonso (2016), people learn in different ways not only because they have diverse skills, motivations and knowledge, but also because they have differing favourite learning styles. The authors consider that teachers should focus on their students' learning and that therefore, methodologies which take learning styles into account represent a good perspective to the improvement of education.

## 5. Conclusions

The study was conducted in the 2014/2015 academic year with a sample of 51 undergraduates of a Management degree course in a Portuguese public higher education institution. The aim was to identify the sample subjects' predominant learning styles using Honey-Alonso's classification into activist, reflector, theorist and pragmatist. We also sought indicators enabling the assessment of eventual relations between each subject's predominant learning style and the variables learning results and frequency of access to the VLE of the subjects' higher education institution.

By using a zero to twenty points scale for each learning style, as assumed in Honey-Alonso's theory, the score means in learning styles varied from 11.8 (activist) to 15.9 (reflector), with 13.5 (pragmatist) and 13.9 (theorist).

Considering each subject's predominant learning style as the one in which they obtained the highest score, we found that the majority of subjects (57%) have a predominant reflector style.

With regard to learning results, although it is not possible to assess the existence of significant differences among the several groups of learning styles due to the characteristics of the sample, we found that the group presenting the highest mean of final marks and the highest mean of number of course units passed is the group with a predominant reflector style.

Regarding the frequency of access to the VLE, the highest mean of number of accesses was found in the students with a predominant pragmatist style (170.3) and the lowest in the activist style (104.4), with (111.0) in the theorist style and (156.8) in the reflector style. With respect to the relation between the set of scores obtained by the subjects in each learning style and the learning results, we found that the correlation between the variables regarding each learning style and the mean of students' marks is low or very low in all situations and no evidence was found to conclude that learning styles significantly influence undergraduates' learning results. Considering the exploratory features of the study and the small size of the sample, the results of this study cannot be generalised. However, they can represent starting points to further developments of the issue regarding the use of VLEs according to students' learning styles in order to improve their academic results.

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# An Axiomatic Approach to Instructional System Design Based on Dick and Carey Model

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**Abstract:** In This paper we have introduced an axiomatic approach to Instructional system design based on Dick and Carey Instructional Design model for developing an online learning course on Intellectual Property Rights. Dick and Carey model is one of the successful and straightforward models for design and development of instructions based on a systems approach, but there are some limitations to follow the various phases of this model in a stepwise manner. So at the first step, we decompose the elements of this model to some basic elements and building blocks. Then each element can be designed and developed separately based on experts' opinions. Based on this approach, we have implemented an instructional design procedure for a training course on Intellectual Property for a target community composed of graduate students in department of entrepreneurship in our university. The results show that with this axiomatic view on individual blocks of Dick and Carey instructional design model, we can easily approach the results of full D&C process. In order to develop this axiomatic approach, at the first step we applied a need assessment analysis based on the requirement of target community, comprised of identification of the problem based on a questionnaire survey, gap analysis, content analysis and technology analysis. In the second step, a learner analysis was done to identify the type of target community including prerequisite knowledge and skills and Learner Motivation. In the third step, Identification of three instructional goals was done, and at the last step, we designed the evaluation tools. We concluded that departing the model into basic blocks, performing each block as a separate task, and then collecting them all together in a final step can effectively achieve the D&C model, while preserving the beneficial of a complete model. We also derived some implications as a recommendation for designing the above mentioned course.

**Keywords**: e-learning, instructional system design, axiomatic approach, Dick and Carey model

## 1. Introduction

Instructional Design that is also called Instructional System Design (ISD) is a process by which instruction is improved through the analysis of learning needs and systematic development of learning materials (Smith and Ragan, 2005). Nowadays, information technology plays a main role in this field and instructional designers most often use computer and multimedia technology as effective tools to enhance instructions in both stages of designing and implementing instructions. According to (Gross, et al, 1997), instructional design models have the ambition to provide a link between learning theories and the practice of building instructional systems.

Instructional Design was come into the world of training after World War II in 1940's in order to provide an effective and efficient way for producing training programs in US military. Since then, more than 100 models for designing instructions have been developed (Abrami, 2006). The root and infrastructural platform of all models is a generic model called ADDIE model. This platform is an acronym and consists of five essential parts of an instructional system named as Analysis, Design, Development, Implementation and Evaluation.

Based on the basic platform of ADDIE, some more applicable instructional design models have been developed based on various design aspects which are called "ADDIE based ISD models". Some of the more important ADDIE based instructional design models are as follows:

- Algo-Heuristic
- Dick and Carey Model
- Robert Gagné's
- Minimalism
- Kemp, Morrison, and Ross
- Rapid Prototyping
- Epathic Instructional Design

Fig. 1 shows a conceptual model of instructional design based on ADDIE platform. This platform is constructed over learning theories and its three famous ideas named as cognitivism, behaviorism and constructivism. ADDIE model is the infrastructure of ISD models, and an instructional system is built over one of the ADDIE based models. In the upper stage, there are three important parts of the system; the training content, delivery platform and instructors that use delivery platform to push the training content to trainees. The task of instructional system is to create, offer and access to training content. Based on an instructional system, in the “Create” section, the training content is developed. Then it turns to “Offer” section, that the type of media is selected in order to deliver the content to the target community in an efficient way. In the “Access” part of the instructional system, the way of content delivery to the trainees and also the method of giving feedback to instructors are investigated. All of the tasks and activities in this conceptual model are put together in such a way so as to achieve instructional goals.

The paper is organized as follow: First of all in the next section, a clear definition of the problem is presented. Section 3 comes with the need assessment including identification of the problem, questionnaire design, gap analysis, context analysis and technology analysis. Section 4 provides a detailed description of learner analysis comprised of Prerequisite knowledge and skills and also learner motivation. Identification of instructional goals will be explained in section 5. We will discuss the designing the evaluation tools in section 6. Conclusion and recommendations for future works will be described I the last section.

## 2. Definition of the problem

Although ADDIE based models are efficient in most cases, but they have some deficiencies. For example, they do not take into account the project cost and time (Van Rooji, 2010). So, we need to make them as simple as possible to achieve project in the right time with an acceptable budget. Moreover, since the task of instructors, facilitators and subject matter experts are migrated in a sense, so some of the stepwise tasks can be done simultaneously.

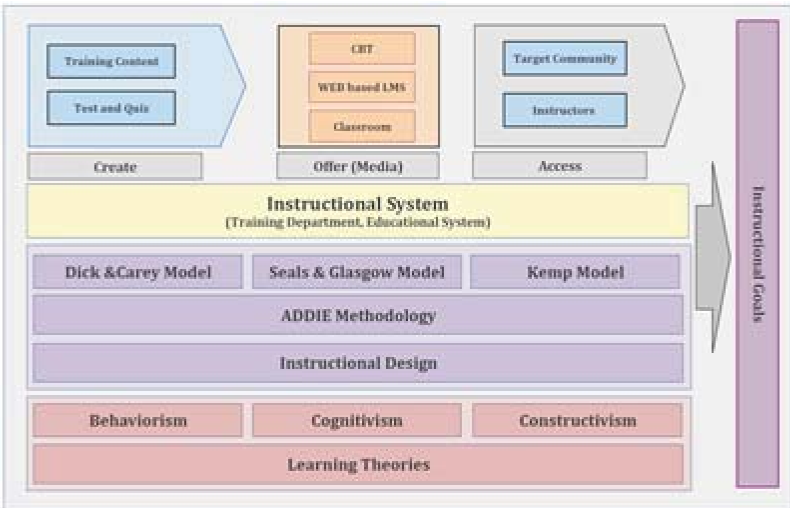


**Figure 1**: A conceptual model of ADDIE based instructional system

In order to develop a complete instructional system, we need an instructor, an instructional designer, a subject matter expert and also a computer expert. As mentioned before, in the real world of education, teachers function as all in one "teachers-designers", who determine the need for instruction, design and develop, revise, and teach the materials they develop (Rogers, 2002). Nowadays, teaching professors, textbooks and packages developed by publishing houses usually serve the function of a subject-matter expert.

In this research, we have focused on design and implementation of instructional design for a training course on Intellectual Property Rights (IPR). Since our main attention was in a skill-based training course, so in this research we selected Dick and Carey instructional design model for this project. The Dick and Carey design model (Dick and Carey, 2001) uses a systems approach for designing instruction. A “systems model” implies that it is more involved with instructional development than design. In other words, the development phase has greater importance than that of design phase. This model is based on a methodology that breaks instruction down into smaller components. It’s approach to design instructions is similar to that of software engineering. It is a learner-centered model, so the target audience plays an important role in the design process. Instruction is specifically targeted on the skills and knowledge to be taught and supplies the appropriate conditions for the learning of these outcomes.

The model selected for this research is a basic Dick and Carey instructional design model. In the following subsections we describe how the various parts of this model are used to implement a course on Intellectual Property Rights.

In this paper, we have investigated an axiomatic approach to ISD using Dick and Carey traditional model. Traditional models are complicated and hard to tune and deploy. To overcome this limitations, the proposed axiomatic framework decomposes the basic elements of the D&C model to a set of functions and a set of constraints (i.e., axioms). The axiomatic framework allows us not only to diagnose the weaknesses of existing model, but also to derive more robust and effective functions. The axiomatic approach has been used in many fields of researches such as Information retrieval (Fang, 2007). There are two major benefits of the axiomatic approach. First, it allows us to diagnose the weaknesses and strengths of traditional models both analytically and empirically. The performance of the model can be improved based on analysing the results. Second, the axiomatic approach provides an easy way to incorporate additional information to further improve the model. In order to implement the axiomatic approach, we should derive some constraints (implications) and also some functions (main blocks of D&C model).

## 3. Need assessment

There are two different ways in starting the ISD process; Starting with the need assessment of the target community, or starting with determination of the goals and course outcomes. In developing a business training package, we should start with gathering requirements from potential users and the goal is to meet the customers' needs. On the other hand, an educational or academic training package starts with analysis of course outcomes and the goal is to introduce and develop some new skills. In the latter case, course outcomes should be aligned with the program outcomes. In this research, we have used the first approach.

There are several approaches that are available to the instructional designers in order to conduct a need assessment process. These approaches includes: surveys, interviews with stakeholders based on a set of questions in a questionnaire, focus groups, observations, analysis of records, academic tests, meeting notes, supportive documents in the target organization, and learning preferences survey. In this project we have used surveys and interviews for gathering information required for need analysis. For this purpose, a questionnaire was prepared based on about ten questions. Because of some privacy restrictions, the students didn't have interest to answer some questions (for example most of them didn't answer the question "are you employed somewhere?"). So we modified the questions in such a way that all students would answer some straight ones, and if some other questions were really required for need analysis, they were asked verbally.

### 3.1 Identification of problem

After reviewing the questionnaire, it was evident that the students have no knowledge in the domain of intellectual property rights. So, due to their education in graduate level in the field of entrepreneurship, they need to pass a training course in this regards.

The need for an electronic learning package for Intellectual property was determined by conducting a prior knowledge assessment of the students' familiarity with Intellectual Property Rights (IPR), and also interviewing with the lecturers. We also conducted some questions representing prior knowledge assessment to the students in a questionnaire. The results of this assessment indicated that the students had a minimal understanding of what the IPR is, the way it could be used, and its impact on the technological world today. The teachers mentioned that the biggest concern was the difference between academic education and the students' skills needed for real world outside the university. The lecturers believe that the students should have enough understanding regarding Intellectual property rights. This is a concern specifically because of the curriculum implemented in entrepreneurship department of the university. As a result, the students need to incept adequate knowledge in order to be successful in their job in future.

In the survey phase, we also discovered the availability of resources and expectations to teach this concept.

## 3.2 Questionnaire results

The questionnaire was gathered from 22 graduate students in entrepreneurship department in the university.

There are some important issues regarding the questionnaires: for example, there is a considerable diversity in the field of B.Sc. degrees in the target community; including industrial engineering, agriculture engineering, computer engineering, entrepreneurship Management, organizational entrepreneurship, herbal production engineering, business entrepreneurship, publishing, and so on. The average age of students in target community was about 28 years old. Moreover, most of them are interested in non-theoretical applied part of the course. The questions and the results of the questionnaire analysis are shown in Table1. The investigation of the questionnaire resulted in following implication:

*Implication {1}: Since the majority of target community is field dependent, so we should pay a special attention to practical part of the course*

## 3.3 Gap analysis

Gap analysis is one of the methods for analyzing the need assessment, which determines the difference between the ideal situation and the actual or current situation. The gap analysis begins with the definition of the ideal situation. Then we should determine the actual situation. The difference between the ideal situation and the actual one is the gap. The goal of the final instructional product is to reduce and minimize the gap. The gap analysis can be done again at the end of the project to determine the effectiveness of the instructional product. Another method for identification of the need for the instruction is the innovation model. When new technologies are introduced to the target community, they have no knowledge about the innovation. Therefore, they will need training courses to implement the change.

In our work to develop the instructional design project, we have used the Gap Analysis model. The gap analysis model has three steps as follow:

**Table 1:** The questionnaire result

| No | Questions | Results |
|---|---|---|
| 1 | Do you have passed any Intellectual Property Training Course? | Only 5% of students has already passed similar course (95% don't have passed) |
| 2 | Do You know anything regarding The concepts of Intellectual Property? | 13% know a little, the others don't know anything regarding this field of science. |
| 3 | What are your expectations of this training course? | To be familiar with its applications and advantages<br>Three persons had No idea<br>To understand the regulations regarding how to protect intellectual property. |
| 4 | Do you Essentially have a sense that this training program will help you in your job in the future? | About 70% agree on usefulness of this course |
| 5 | What is your idea about planning this course in an electronic e-learning environment? | That's good but it's better to run the program as a short course in summer school Between Semesters. It means not along with a formal semester<br>Most of us are employed, so it's a good idea |

### *3.3.1 Determine the ideal situation (TO BE)*

The first step is to determine the ultimate situation for the case of training course in IPR, which is defined as follows; The ideal situation would be for each student to demonstrate his/her knowledge with about 80% accuracy of what Intellectual Property is, variants of IP rights, how they could be used for supporting entrepreneurs in the world today and how these rights can be localized according to situations in each country. The target community should also have a moderate capability to search in patent databases as a patent examiner.

#### *3.3.2 Determine the actual situation (AS IS)*

In the next step, we should determine the actual situation. The actual or current situation as demonstrated by the prior knowledge assessment indicated that only 5% of students had a minimal understanding of the concepts of Intellectual Property, its importance for supporting entrepreneurs, and the role of IPR in technology development. Also there is no understanding about its impact on economic development.

#### *3.3.3 Describe the gap*

In the third step, we should determine the difference between the ideal and actual situations. Based on the expectations of lecturers and the results of the prior knowledge assessment, there was an evidence of an existing gap. Due to this gap, there is a need for the development of an instructional system that would increase the understanding of Intellectual Property, or in other words, decrease the gap. Currently, there are no comprehensive academic training materials localized to the country available to instructors and trainees that address this topic. Furthermore, due to the lack of time, lecturers cannot engage in preparing assignments in other courses to have meaningful hands-on activities for this field of knowledge. Therefore, the students do not have the opportunity to be familiar with these concepts in other courses. The investigation of gap analysis was resulted in implication {2} as follow:

*Implication {2}: The Instructors in related academic courses should prepare assignments in such a way that students can obtain effective and meaningful hands-on experiences in IPR.*

### 3.4 Context analysis

The purpose of context analysis (also named as learning environment analysis) is to examine the factors which could potentially impact on the instruction. The analysis should take into account the outer system where the instruction will be taking place. There are six factors that should be considered as follows:

Characteristics of the trainer: An instructor with good experience in patent registration and intellectual property rights, with more than 8 years of experience working in the related fields was considered to act as a facilitator. The role of the facilitator is to act both as a subject matter expert and an instructor.

Learning materials: There are good training materials in the website of World Intellectual Property Organization (WIPO), and also in some books and lecture notes of the trainers. Moreover, there exist some materials of several workshops instructed by foreign experts in Iran. These materials currently available to the instructor and can be used as building blocks in the course.

The existing facilities: There is a computer room in the department and also a Learning Management System in the university as a software platform. Moreover, all of the students have notebooks with internet connection.

The training environment: The main goal of department of entrepreneurship is to train students in the related fields and leverage their skills. So this department is a suitable place or may better to say the best place for performing this course.

Prohibitions: There are no special limitations and restrictions in the department and in between target community.

Time Limitation: Many of students in target community are employed somewhere and encounter difficulty with the time required for this course. So, an e-learning environment can help us to overcome this problem.

An implication which can be derived from above mentioned factors can be depicted as follows:

*Implication {3}: The course lessons should be scheduled and spread in time in such a way not to affect the academic training courses they are involved and also their job.*

### 3.5 Technology analysis

Training material should be effectively delivered to the learners. In this phase we should identify technology available in the training environment. Selecting good technology tools also depends on the type of learners and lecturers. We should also investigate what type of technology available to the instructor and the learner. Since we use web based environment, so adequate technology should be prepared to support web and multimedia.

All the learners have computers in their home and also notebooks with adequate quality and speed. There are also some computers with Internet access in the computer room in Entrepreneurship Department. So, the students can access to the learning environment with ease.

In order to construct a platform for the instructional system, a three layer structure was developed. The first layer of this platform on the top provides the "content" of IPR training course. In the second level, we have a badging system for assessment and evaluation of learners' activities, which in our situation we have used a Moodle platform. The third layer on the bottom has the role of connecting the learners to each other for knowledge sharing that can be implemented using a Social Network System (SNS) such as Facebook or an LMS forum.

## 4. Learner analysis

We should identify the type of learners participating in the instruction. Learners may have similar characteristics, so we should characterize their attributes. Knowing the learner's capabilities assist the designer to prepare appropriate instructional material to generate interest and create motivation.

### 4.1 Prerequisite knowledge and skills

The learners are graduate students at the department of entrepreneurship of the university. These students have minimal prior knowledge of Intellectual Property Rights. Many of them are aware that there is a need to know various aspects of this field of knowledge, but there has been no kind of structured training course yet.

General information: There are about 40 students in our target community, 85% of them are male. The students ages range from 24 to 30 years old with average 28.

Educational level: The learners are graduate students in the field of entrepreneurship. They have a wide range of majors in their B.Sc. degrees.

Achievement level: As stated by representative members of the target audience, they are in a moderate level.

Socioeconomic background: There is no information of economic background of these students, but the social background are approximately the same because they are approximately in the same range of age.

Learning styles and preferences: These students prefer to learn visually, which makes us use photos, pictures, and graphics (results in implication {4} below). Due to limited resources, there are no movies and animations available. The most effective activities are experiments and hands-on learning. The students have a good digital literacy and all have a moderate access to the internet.

*Implication {4}: Since the students prefer to learn visually, the instructor/facilitator/subject matter expert should prepare learning content with graphics, animations and simulations.*

Learner attitudes: All of the students are employed and searches for knowledge and skills that help them leverage their position in their jobs. As a result, the students have a good attitude, and motivated to learn. The students are under pressure for their academic courses. But for this short-term IPR skill-based course, there is a lower motivation. Two solutions can be applied. The first way to motivate them is giving certificate to successful attendees (see implication {5} below), and the second way is to negotiate with the department administration to make the students take the course as a need.

*Implication {5}: In order to motivate the students to have active participation in the course, the department should prepare certification for successful attendees.*

Learner expectations: The students have no idea regarding their expectations of the course. So at the beginning of the course they should be notified about the course objectives and outcomes and also prepared by the subjects and title of lecture notes.

*Implication {6}: Learners should be told the explicit outcomes of the training course and its benefits, so that we can set some expectations for them to assess themselves at the end of the course that if they reached the outcomes or not.*

There is a lack of familiarity with the technology in between students. This lack causes some limitations; for example some of students are not in the same level of e-readiness. They should pass a prerequisite computer course. As another limitation, students may not know how to work with Patent web sites for a complicated search. So, we should provide them example exercises within the course. Some students may have little experience with distance learning. Others may begin to feel lost in the course without some contact. So we should schedule at least two face-to-face meetings of learners with the instructors during the course to provide feedback and help.

### 4.2 Learner motivation

There are some approaches to investigate the critical factors affecting learners' satisfaction (Sun, et al, 2008). In this research we use ARCS model (Attention, Relevance, Confidence, Satisfaction strategies) which is an effective tool to determine the motivational attributes (Keller, 2009).

Attention: The attention of the students is good because these students have prior knowledge of entrepreneurship to attain the concepts being presented. In order to enhance their attention, the students need several actual samples to get their focus. This can be accomplished by visual presentations, hands-on activities, and explaining a variety of experiences, results in the following implication.

*Implication {7}: The material should be enriched with lessons learned, success stories, and best practices achieved in the field of intellectual property (ARCS attention). Moreover, use of humour in presentations can increase learners' attention.*

Relevance: The relevance of this instruction is high because all of the concepts are related to entrepreneurship principles, which is the main stream of their academic course.

Confidence: The confidence levels of the students is also in a accepted level, this is because they have passed a difficult entrance exam, they all have employed somewhere, and have good job positions. Moreover, the relevance of their academic courses with IPR course, make them confident to easily pass this short course. The students will also work in pairs for the assignments to increase the confidence levels. As a result an implication can be obtained as follow:

*Implication {8}: The students should work in pairs for the assignments to increase their confidence levels. (ARCS confidence)*

Satisfaction: The students will receive satisfaction by announcing the grade of best ones in the learning environment. They can also be satisfied by a certification signed by the head of the department.

## 5. Identification of instructional goals

As a result of the need assessment phase, the learning objective is as follows: "At the end of the training course on Intellectual Property Rights, the learner will be able to express all IP Rights categories, explain Iranian IP laws and ratifications, to address international treaties and to efficiently search in patent data bases."

We can also set three business goals for this online course. First, this course should result in capacity building in students. Second, this course should leverage the e-readiness capability of the learners. And as a third business goal; by running this training workshop in web environment, the department of entrepreneurship should save at least 30% in time and cost comparing to instructor-led physical classroom.

## 6. Designing the evaluation tools

The assessments and tests should be created in such a way to reach instructional goals and learning objectives. Since the e-Learning platform that we planned to use as LMS has many capabilities for assessing the learners, so the direction of assessments and scoring methods are based on this platform (Costa, Alvelos, and Teixeira, 2012, López, et al, 2016). Remember that some appropriate assessment tests should also be designed for evaluating the entry level skills of the learners (Kanuka, 2006). Moreover, we require to build a bridge between this skill based course and academic courses. This can be appeared in assessments and evaluations.

*Implication {9}: The assignments should be prepared in such a way to connect the learners' activities to their academic courses they have passed in the field of entrepreneurship. (ARCS relevance)*

The question forms should be designed in such a way to test deduction capability of students, their skill for searching in patent databases, and also some kinds of question/response types such as multiple choice, multiple response, Image hot spot and fill-in-the-blank.

## 7. Conclusion

In this paper, an axiomatic approach for Instructional System Design based on Dick and Carey model was investigated. This approach was deployed on a short course for Intellectual Property for an online e-learning system. We concluded that departing the model into parts and performing each block as a separate task can achieve the complete D&C model, make it simpler to implement and time consuming. We also derived some implications as recommendations which are beneficial for designing and developing the above mentioned course. As a step toward future works, we should prepare an integrated authentication framework to prepare a single sign on (SSO) structure for all three above mentioned technology layers.

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# Socratic Flipped Classroom: What Types of Questions and Tasks Promote Learning?

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**Abstract:** Socratic questioning stresses the importance of questioning for learning. Flipped Classroom pedagogy generates a need for effective questions and tasks in order to promote active learning. This paper describes a project aimed at finding out how different kinds of questions and tasks support students' learning in a flipped classroom context. In this study, during the flipped courses, both the questions and tasks were distributed together with video recordings. Answers and solutions were presented and discussed in seminars, with approximately 10 participating students in each seminar. Information Systems students from three flipped classroom courses at three different levels were interviewed in focus groups about their perceptions of how different kinds of questions and tasks supported their learning process. The selected courses were organized differently, with various kinds of questions and tasks. Course one included open questions that were answered and presented at the seminar. Students also solved a task and presented the solution to the group. Course two included open questions and a task. Answers and solutions were discussed at the seminars where students also reviewed each other's answers and solutions. Course three included online single- and multiple choice questions with real-time feedback. Answers were discussed at the seminar, with the focus on any misconceptions. In this paper we categorized the questions in accordance with Wilson (2016) as factual, convergent, divergent, evaluative, or a combination of these. In all, we found that any comprehensible question that initiates a dialogue, preferably with a set of Socratic questions, is perceived as promoting learning. This is why seminars that allow such questions and discussion are effective. We found no differences between the different kinds of Socratic questions. They were seen to promote learning so long as they made students reflect and problematize the questions. To conclude, we found that questions and tasks promote learning when they are answered and solved in a process that is characterized by comprehensibility, variation, repetition and activity.

**Keywords:** flipped classroom, questions, tasks, Socratic questioning

## 1. Introduction

In higher education, the flipped classroom is sometimes presented as being completely different from traditional university teaching (Bishop & Verleger, 2013; McCarthy & Anderson, 2000). As such, it is an active learning approach that seeks to allocate more time to teacher and student interaction than would be the case in traditional teaching (Kvam, 2000; Prince, 2004). Researchers have found that students and teachers perceive the flipped classroom approach as a positive experience (e.g. Galway et al, 2014; O'Flaherty & Philips, 2015). Other studies have indicated that it can also improve student performance (e.g. Mason et al, 2013; O'Flaherty & Philips, 2015).

The flipped classroom method is often related to eLearning, which is a natural assumption since ICT is often used to record, distribute and consume learning content. Whilst ICT is simply a medium, it does provide opportunities to take a pedagogical approach based on the idea of active learning (Avdic & Åkerlund, 2015). ICT is of course not a pedagogical approach in itself; it can, however, strengthen certain aspects of learning, such as the flipped classroom. Like all pedagogical approaches, the flipped classroom can only succeed if it is exercised in an effective way. Indeed, there are several factors that can affect the effectiveness of a flipped course. Regardless of the quality and content of the digital recordings that are normally used, the types of questions and tasks assigned, along with the digital presentation itself, are of crucial importance. These questions and tasks are the triggers of the learning process.

Questioning is central in all kinds of education. Above all, it is used to promote learning and to assess performance. Teachers ask students all kinds of questions for various purposes. When the learning purpose is descriptive, these questions are accordingly descriptive. When students are expected to demonstrate analytical and evaluative skills, they are more refined in order to reflect a specific kind of knowledge and skills.

In this paper, our aim is to investigate how students perceive different kinds of questions from a learning perspective.

## 2. Theory

As far back as the ancient Greeks, there has been an interest in how to question in order to learn. Socratic questioning stresses the importance of questioning in learning, which is why it is still relevant to any discussion of how to learn today. Socratic questioning is different from questioning *per se* in that it is systematic, disciplined, and deep. Usually, it focuses on fundamental concepts, principles, theories, issues or problems. This is very much in line with teaching in higher education that promotes analytical and critical skills as the highest form of learning (Law of higher education, 1992).

According to Socratic questioning, a question is not just a question and an answer. It is a dialogue that can be used by a teacher to answer a question in order to search for further relevant answers and reflections.

Van Aswegen et al (2011) exemplified six ways of posing questions in a Socratic manner.

- Getting students to **clarify their thinking** 'Why do you say that?', 'Could you explain further?'
- **Challenging** students about assumptions 'Is this always the case?', 'Why do you think that this assumption holds here?'
- **Evidence** as a basis for argument 'Why do you say that?', 'Is there reason to doubt this evidence?'
- **Alternative** viewpoints and perspectives 'What is the counter-argument?', 'Can/did anyone see this another way?'
- **Implications and consequences** 'But if... happened, what else would result?', 'How does...affect...?'
- **Question the question** 'Why do you think I asked that question?', 'Why was that question important?', 'Which of your questions turned out to be the most useful?' (Van Aswegen et al, 2011)

Questions can focus on different aspects of knowledge domain, such as concepts or theories. Questions can also take different forms, even if they focus on the same kind of knowledge type, e.g. concepts or theories of a knowledge domain. Wilson (2016) put forward five types of questions in which different kinds of thinking and knowledge are targeted.

- **Factual**. The answer can be found in the literature. Answers are right or wrong. 'What kinds of software tests are there?'
- **Convergent**. Students are asked to justify their answer when the justification can be found in the literature or in the light of evidence offered or the inferences made. 'Considering a hierarchy of goals, which goals are conflicting?'
- **Divergent**. Includes valuing, organization, or characterization. 'If an organization is planning to implement an ERP system, how can they proceed if none of the ERP system candidates do not fulfil their main requirements?'
- **Evaluative**. Sophisticated cognitive and/or emotional (affective) judgement. 'What kind of research strategy is most relevant when carrying out a literature study, and what are the consequences of the alternatives?'
- **Combinations**. Any combination of the above.

Above, we have presented two categorizations of questioning that pose different challenges for students. As a teacher you need to make assumptions about which types of questions and tasks are most effective in a learning situation. But how do we know how this is perceived by the students? This question is the motivation for this paper.

## 3. Method

This paper takes a case study approach, using focus group interviews for data collection. Our three cases are courses in Informatics at Dalarna University in Sweden. The courses all ran in the academic year 2015 to 2016. The cases are presented in more detail in the Results section below.

Focus group interviews were carried out in groups that each comprised between five and eight students. Each interview lasted about an hour. The interviews were recorded and transcribed with the permission of the participants.

The aim of the interviews was to allow the students to reflect upon the questions and tasks they had to answer/perform during their particular Informatics course. We selected examples of questions and tasks (see below) and presented them to the students for reflection on how they found them to be effective from a learning perspective.

The questions asked during the interviews were about:

- how different kinds of questions and tasks mattered from a learning perspective.
- how the students thought and acted when they were looking for answers.
- which questions were less effective and more effective
- how the videos, recordings and textbooks were used to answer questions
- the role of the seminar with regard to discussions, seminar tasks, and presentations for answering questions or solving tasks.

We analyzed the material both inductively and deductively. During the inductive analysis, we looked for what the students perceived as effective for learning without considering the categories in the Theory section. After that, we compared our findings with the theoretical categories. We then organized our findings accordingly.

## 4. Results

In this section we present our three cases and findings from the focus group interviews with students from three flipped classroom courses. The courses are part of a three-year Bachelor program in Systems Science.

### 4.1 Course one

The first course, Research Methods, runs in year one. Learning outcomes focus on an understanding of and ability to use and motivate strategies, data collection and data analysis. The course consists of laboratory work, seminars, video lectures, and one individual and one group assignment. Five video lectures cover the main topics. The lectures and seminars are based on the main textbook: "Researching information systems and computing" (Oates, 2006). The flipped classroom approach is carried out through the videos, textbook and seminars. The course study guide presents the students with a number of questions (normally 10 to 12) that they are supposed to answer individually in writing and submit the day before each seminar. Seminars last for two hours and are divided into two parts. First, the students take turns to explain their answers to the questions (see Table 1). Secondly, they get a report that is relevant for the seminar topic, together with four questions (see Table 2). The answers to these questions can be found in the report and are presented using PowerPoint to the rest of the group. The process is depicted in Figure 1 below.

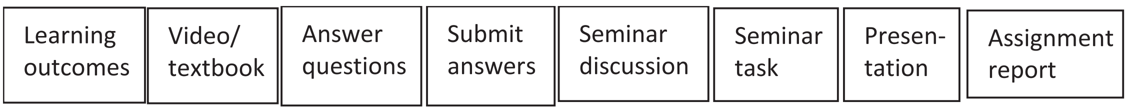


**Figure 1***:* Course one – the flipped process

Below are examples of questions that students are supposed to answer before the seminar.

**Table 1***:* Questions

| |
|---|
| Survey |
| What is a Survey strategy? |
| How can you plan and design a Survey? |
| How can you evaluate a Survey strategy? |
| Is there something in the study material that relates to such strategies that needs to be discussed and explained? |

**Table 2***:* Seminar questions

| |
|---|
| What motives are presented for the selected strategy? |
| How is the selected strategy described? |
| How is the strategy used in the study? |
| How are the limitations of the strategy described? |

## 4.2 Course two

The second course, Change Analysis, runs during year two. Learning outcomes are related to the skills and abilities needed to conduct a change analysis and the students' ability to evaluate different analyses so as to propose changes needed to the studied case. The main learning activities in the course are six mandatory seminars and project work, whereby the students perform a change analysis at a company or organization. Answering the seminar questions and the project work are group activities. For each seminar there are pre-recorded lectures and recommended reading. The seminar questions are disseminated to the students one week before the seminar and the students submit their answers and solutions to the questions before the seminar. They are also expected to look at and comment on another groups' answers before the seminar. For the seminar questions, they are given a case description of the fictional company used for their analysis. The first four seminars focus on a specific part of a change analysis (such as problem analysis or goal analysis), and the last two seminars focus on methodological questions and information literacy.

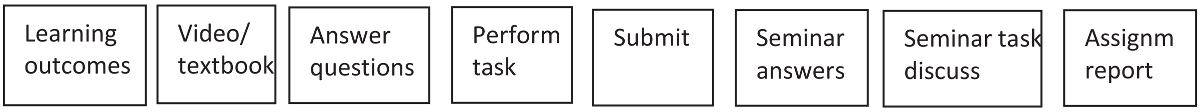


**Figure 2**: Course two - the flipped process

Examples of questions that students were supposed to answer in writing and submit before the seminar. The examples are from the seminar on business analysis.

**Table 3*:*** Questions that are supposed to be answered before the seminar

| |
|---|
| Task A: Study an alternative way to describe processes in an organization and answer the following questions: 1) What are the advantages and disadvantages of different notations? 2) What are the implications of different graph techniques that model different concepts? |
| Task B: Describe some general rules for the way that action graphs should be drawn. 1) What should you consider? 2) What should you avoid? |
| Task C: There are two ways of looking at a business: from a process-oriented and function-oriented approach. A process-oriented approach is often seen as a better option. What arguments are used to support a process-oriented approach or a function-oriented approach? |
| Task D: What have you experienced as difficult or complicated in business analysis? What would you like to discuss in the seminar? |
| Task E: Make a process graph for the Datadalens cottage rental service (the fictional company that we used as a case). |

## 4.3 Course three

The third course, Maintenance and Testing of IT Systems, runs during year three. Learning outcomes focus on the acquisition of knowledge and understanding of systems maintenance and the testing of IT systems. The course comprises three parts, which are examined in three different ways. The first part focuses on systems maintenance and consists of four seminars, which are examined through seminar participation and by writing an assignment report. The second part focuses on the testing of IT systems and consists of four video lectures based on the main (Swedish) textbook "Test and quality assurance of IT-system" (Eriksson, 2008), and an online quiz, followed by a seminar and a laboratory task. The latter is examined by a laboratory assignment report. The third part is a project examined by a project report and viva. Flipped classroom pedagogy is used in the second part of the course. Neither the quiz nor the seminar are mandatory; however, in order to attend the seminar students have to complete and submit the quiz, with 35 multiple choice and yes/no questions, beforehand. The questions are based on the four video lectures, which contain information that the student will need in order to complete the laboratory assignment report. The quiz is available online on the Fronter LMS. The students can have one attempt at the quiz, for which there is no time limit. The purpose of the quiz is to detect the areas that the students have not understood or have misunderstood from the video lectures. These areas can then be discussed during the seminar In order to fill the knowledge gap and prepare students for the laboratory assignment that follows. The class is divided into groups of 10 to 15 students during each seminar which is somewhat more than the other two courses. Throughout the seminar the students are presented with the overall result of each question in the form of diagrams (not individual results). The seminar participants focus on the discussion of those questions for which incorrect answers have been given. Figure 3 below illustrates this process.

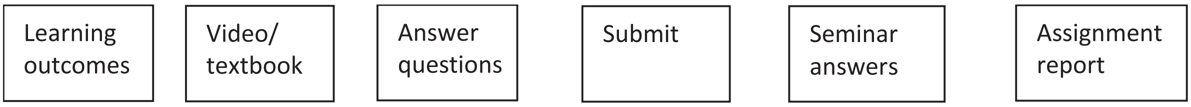


**Figure 3**: Course three - the flipped process

Factual questions are used in the quiz that the students are required to answer and submit before the seminar. Two examples of quiz questions are:

- Testing tools are only used in automated tests.
- *Yes*
- *No*
- Examples of tests that take place during systems maintenance are (multiple choice question):
- delivery tests
- regression tests
- planning tests

During the seminar the questions with wrong answers are discussed and the participants can clarify the answers. The Socratic aspect was planned to be implemented during the seminar, where we expected a discussion/dialogue to take place about the answers that were not correct.

## 5. Findings and analysis

### 5.1 Course 1

Overall, the students said that the questions and tasks should be comprehensible and not too complicated. Even if a question was quite simple and could be answered just by finding the answer in the textbook or in the recording, the search for the answer, or the search for the meaning of a concept, made the students more aware of the context of the question. Furthermore, the discussion at the seminar brought more meaning to the specific knowledge domain. Students found it frustrating when they were not sure what was actually meant by a certain question. One student stated: “You shouldn’t have to use half the time to try to understand what a question is about”. The question about how to plan and design (Table 1, question 1b) was favored by several students because it made them understand a context rather than just a fact or a concept. It also made them read more of the section about the studied concept in order to answer the question. When the students submitted their answers, relatively few of them answered question 2 about what needed to be discussed or explained. They claimed that the reason for this was that they knew they could discuss this at the seminar. Some students were also rather afraid to reveal their ignorance.

During the first part of the seminar, when the students presented their answers to the questions they had prepared, the teacher asked Socratic follow-up questions, such as “Can you explain what is the main purpose by triangulation and give an example?”. One Socratic way to promote discussion, which was mentioned in the interviews, was ‘Alternative viewpoint’. This was directed to the rest of the group after a question was answered by a student. ‘Clarify thinking’ was also almost mandatory when something in the answer was not clear. All kinds of Socratic questions were used, except for the sixth question. Even when the original question was factual, convergent, divergent or evaluative, the seminar follow-up question could be any of the Socratic questions.

As for the questions that were supposed to be answered and presented during the seminar (see Table 2 above), almost all students were positive. They had to answer questions and present their answers to the others, all in 45 minutes. Because they didn’t have much time, they had to be very efficient. Most of the students, although not all, found this to be a positive challenge. Comments included: “It was really rewarding to do something yourself”. “The first time it was scary. After a while I looked forward to the presentation”. When first faced with this challenge, the students thought it would be impossible to find answers and make a presentation in 45 minutes; however, when they saw that it was indeed possible, they were stimulated by the challenge.

To summarize, the students considered the following aspects to be important from a learning point of view: comprehensible questions and tasks, variation in the material’s format, repetition of the information in various forms, active ways to process information, and the presentation of the answer to the question to the others. We used factual, convergent, divergent and evaluative questions. During both parts of the seminar, including the presentation, discussions included Socratic questions.

## 5.2 Course 2

Overall, the students liked questions that required them to actively look for answers from different sources and where they had to make sense of different concepts. For example, Task C in table 3 required the students to find out the meaning of two concepts and compare them with each other. Comparing these types of questions to more factual questions that can easily be found in the texts, the students felt that questions where they had to investigate something were more beneficial for their deep learning than factual questions that were easily forgotten. However, they felt that factual questions and more investigative or practical questions could be combined to further stimulate their learning: "The questions can be combined, you can have 'small' questions, words, concepts, that later activate you when you have to apply them". Furthermore, the factual questions were discussed during the seminars to increase the students' understanding of different concepts. For example, if the students were asked to list what should be avoided in a specific graph technique, follow-up questions should ask for any reasons why something should be avoided, the implications of ignoring the rules and so on.

One problem identified by the students was that some of the questions in this course used words that they did not know the meaning of. These were words that we, as teachers, took for granted. When the questions were not clearly formulated and understood by the students, it led to frustration. This was also apparent in the groups' answers during the seminars, where poorly formulated questions more often had answers that where wrong, or only partially correct.

A reoccurring question in all seminars was that we asked the groups to state what they had found most difficult, and what they wanted to discuss during the seminar (see Task D, table 3). Not all groups answered the question for all the seminars; however, the ones that we interviewed felt that the question had an important function. Having the ability to decide what to discuss was an opportunity to "get something more, or better explained in the seminar instead of having to try and figure it out from the textbooks". The reason that not all groups answered the question was thought to be that they did not want to look stupid in front of their peers.

A question that was included in the first four seminars was related to the modelling of graphs based on a case description (see Task E, table 3). In this question the groups had to apply what they had learned in a more practical activity. These types of questions were appreciated by the students: "In these types of questions, the things you have asked earlier reoccur. You talk about it, in the recorded lectures for example, and you think 'okay, this is easy' and then you have to do it yourself and you notice how difficult it is. You have to start to think about what you are doing". Hence, the students felt that it was difficult to grasp the complexity of things by just seeing or hearing someone else talk about it. They had to apply it themselves in order for the "thought process" to start. After the students had presented their graphs there were more discussions and follow-up Socratic questions (both from the teachers and the other student groups), where different solutions, motivations for a specific solution, and so on, were presented. Thus, the students had to re-think their original answers, and thei initial assumptions, leading to further improvements in their learning.

## 5.3 Course 3

Overall, the students preferred questions that were clearly formulated. They liked the quizzes, because they were presented with various possible answers, which helped to clarify the questions. When comparing this format with one that involved writing answers to questions, one student stated: "If you are to write your own answers you do not know if you have understood the question". Another student thought that having options to answers contributed to learning: "You learn even from the answers available".

The fact that the students had to answer the questions in the quiz motivated them to listen to the video lectures. Several students agreed that it helps with the motivation to learn if they understand the purpose of listening to the video lecture. It also helps if the subject is interesting. Another aspect that affects their learning and what they do before a seminar is how the seminar is structured. If the students are supposed to be active in the seminar it motivates preparation. It was also found that the way in which they are supposed to participate also affects preparation. The learning that takes place in the seminar is helped by discussions. According to one student: "It is always good to discuss". On the other hand, one student stated: "It is easy to just take a more passive role and just go with the flow with what others discuss during the seminar".

The types of questions in the quiz can influence the learning process. One student thought that: "Yes/no questions do not contribute to more knowledge". Multiple choice questions, which offer the possibility of several correct choices, were also seen to be good for learning. As one student put it: "You have to think a little harder".

Knowing that they would complete the quiz after listening to the video lectures affected the way some of the students listened. One student stated: "I was looking for special sentences". According to another student: "I was memorizing words". Comparing a quiz like this with writing answers to given questions, one student said: "If I write my own answers I would try to understand the subject and the text more". Thus, the quiz resulted in surface learning rather than deep learning. In addition, the way the students prepare for quiz-type questions, by looking for facts in the video lectures, does not promote deep learning. One student stated: "… I forgot the facts shortly after the quiz". With this in mind, it was harder to engage the students in deeper discussions during the seminar that followed. It was also hard for the students to talk about the correct answers, because they expected someone else to provide these during the seminar. However, the quiz did help the students to gain an awareness of what they had understood from the video lectures. One student stated: "The quiz helped me to know that I was on the right track after all". The students also appreciated that they could see the result after the quiz was submitted: "That was the best."

To summarize, the students approached the quiz by looking for words and definitions, and memorizing these, while listening to the video lectures. The yes/no type of questions asked in the quiz were not perceived as helpful for learning; however, the multiple choice questions could be seen as a part of the learning process, itself. Thus, students' awareness about how they are going to participate in the seminar does affect how they go about preparing for the seminar.

## 6. Discussion and conclusion

All three courses applied different means to support flipped classroom learning. They all included recordings and questions that had to be answered before the seminars. Course 1 included task solving and the presentation of the solution during seminars. Course 2 included a task whereby the students had to analyze a case and present a solution graphically. Course 3 provided an online quiz with instant correction of the answers and a discussion of the answers at the seminar.

We found that a fundamental demand on a question is that it should be comprehensible and indicate a direction for where to look and how to search for the answer. Dubious or fuzzy questions are counterproductive and cause students to lose energy and motivation. This is regardless of whether the question is factual, convergent, divergent or evaluative.

The motivation to read, listen and reflect upon the initial questions depended on what happened in the seminar. Courses 1 and 2 included planned seminar discussions about the answers submitted, where all students had to take an active part. After a student had presented an answer the teacher usually either asked the student a 'clarifying' question or posed an 'alternative' question to the rest of the group about other viewpoints. Some answers led to 'implications' questions and others to 'challenge' or 'evidence' questions. The students perceived this discussion to promote learning as it provided repetition from different perspectives. In addition, the students had to process the information through presentations or a case analysis. We consider this method of learning to be 'evaluative'. Together, these learning methods generated a number of activities for each initial question. This flow of activities included a seminar discussion, with Socratic questions mostly posed by teachers but also by students. After the verbal processing the students also had to apply the knowledge gained. This mix of practical and theoretical activities was appreciated by the students, because of the variation and repetition aspects, and their perceived effect on learning.

The seminar in course 3 included students' presentations of the answers and an opportunity for them to discuss the answers, especially those that were incorrect. This discussion could eventually include most Socratic questions; unfortunately, the students were not prepared for these. So when comparing the three courses the third course with quizzes generated less discussions. We can only guess the reasons for this. One reason might be the size of the seminar groups and the room arrangements. When the students in course one and two sat around a table in smaller groups, the students in course three sat in a regular classroom behind each other and in larger groups than the other students. Another possible reason could be the fact that the students were not prepared for a discussion. We thought that the discussion might start by itself when we presented the results and the answers. But this didn't really happen. So in all we can't say that quizzes are less suitable for Socratic questioning before we have tested another seminar approach with fewer students and prepared questions covering different kinds of Socratic questions.

In all, we found that any comprehensible question that initiates a dialogue, preferably with a set of Socratic questions, is perceived as promoting learning. This is why seminars that allow such questions and discussion are effective. We did not find any difference between the different kinds of Socratic questions. As long as they made the students reflect and problematize the question, they promoted learning.

To conclude, we found that questions and tasks promote learning when they are answered and solved as part of a process that is characterized by comprehensibility, variation, repetition and activity.

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# Analysis of the Student's Interaction Using Videostreaming at University Physics Classes

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**Abstract**: In the context of incorporating information and communications technology (ICT) tools in the School of Engineering at the University of Buenos Aires, videostreaming is used as a communication resource in a Physics I course on b-Learning for problem solving and practical classes. It allows synchronous conferencing, which is increasingly becoming an integrated part of the teaching-learning process and facilitating teacher-student and group communication. The bachelor in engineering -in a six year programme- is organized in massive classes in the first years, so one-to-one synchronous interaction and students' engagement and motivation are difficult to achieve. With the objective of revealing students´ different ways of interaction, videostreaming classes have been recorded and every instance of student participation has been analyzed. The following questions are proposed so as to define categories of analysis: what is the kind of participation that occurs in video streaming sessions? How do students and teachers use this communication tool? And how is this tool integrated into the teaching design? A descriptive longitudinal research was carried out to answer the above-mentioned questions. Moreover, the Physics course design is evaluated so as to understand how the tool was implemented, and to signpost the relevant resources. Videostreaming was applied as an additional tool in the Physics class to enhance discussion of theoretical concepts and to resolve problems with the guidance of the teacher. It allows the interaction with a large number of students in a very clear and concise way, thus achieving better interactions than those in a traditional face-to-face classroom. It has proven to be an effective tool for engaging students in active learning in massive classes. It makes students feel more motivated to ask questions. From the point of view of learning, this tool allows students to review and construct theoretical concepts, especially complex ones. Not only is the learning process of new content facilitated but also is the acquisition process of scientific vocabulary, necessary for students to express their own ideas and doubts. Students are challenged to communicate in writing with the teacher and with other students in this context, which is not possible in face–to–face classes.

**Keywords**: videostreaming, action research, physics classes, interaction, flexible learning

## 1. Introduction

Since 2012 the School of Engineering has implemented several educational resources in its virtual campus. In search of the best device that meets specific needs, a tool to facilitate group communication and the learning environment was included on it. That is why, after analyzing the market possibilities, online classes were put into practice by using a videostreaming platform.

This new tool facilitates the design of strategies for analysis, discussion, and proposals for solutions to real problems by studying the limits of validity of the physical models involved. In these sessions – which include presentations, videos, and explanations on the whiteboard- various resources that are supported by the system were incorporated. Depending on the didactic need raised and according to the results obtained, videostreaming is presented as a synchronous application of good technological response. It allows to jointly address the posing of problems and the analysis of their possible solutions.

Video streaming is a tool that is used in courses on b- Learning which unfold in the university campus. It is used to teach how to solve problems, and to provide a participation environment where the students can work at the same time. Prior to the synchronous class, teachers inform students of which problem will be resolved in order to motivate participation. On the other hand, in face to face classes, most of the time is destined to develop the theory models with a few examples of typical problems. It is mainly an expository class.

The implementation of the synchronous class can be divided into three parts:

- A pre class where the problems to be discussed are presented to students in the platform, which is an institutional campus virtual classroom.
- The synchronous class by streaming, which is recorded simultaneously

- A post class in the campus, where students can watch the recorded class and make questions, or write their doubts in an asynchronous forum.

## 2. Theoretical framework

The model that guides this research work is the paradigm of interaction, which postulates the existence of variables and conditions that may facilitate learning. From the point of view of the processes of joint construction of meaning, and in order to increase certain types of interaction among student-teacher-content, teaching strategies are developed. The constructive mental activity of students brings out a set of elements, such as basic cognitive abilities, specific domain knowledge, learning strategies, metacognitive skills and self-regulation, motivations and goals, mutual representations and expectations, etc., which are critical for quality learning. Thus, promoting virtual learning is not only presenting information or designing tasks to be performed by the student, but essentially following up the learning process, and providing the necessary support and resources (Rochera et al, 1992; Onrubia, 2005).

These new spaces of communication along with some asynchronous tools such as forums and wikis, allow for the design of collaborative learning strategies. Adell based these learning strategies on several assumptions: a) people learning the best through active experimentation and reflective discussion, b) the role of the teacher as facilitator of learning, c) knowledge as a social construction developed in cooperation opportunities, d) students enhancing their metacognitive skills such as learning to learn (Cabero Almenara et al, 2000).

The boom of video in 2005 (Llanos, 2008) gave rise to different platforms or web services which dominate a market that was generalist in its origins and that intended to offer information about any subject. Gradually diversification appeared, along with alternatives to cover small market niches. Videostreaming is the technology that allows transmission of multimedia files (audio or audio and video) over the Internet. The main difference with traditional methods is that in order to watch a video, it is not necessary to download it to the computer. The server sends fragments of the file at the same time it is requested and at the rate the bandwidth of the connection permits. Due to the type of features of this technology, it can be used in two scenarios: 1. emissions of live events; 2. distribution of pre-recorded media files. In the latter case, the server stores media files which can be accessed at any time by students through the Internet. An example of a type 1 system is Skype and of a type 2 system is YouTube (Aveleyra et al, 2015).

The adopted platform has the following characteristics: a) it does not have to be installed on a user's machine; b) it uses a peer-to-peer protocol, which means that each user connects with the permissions and role assigned to a platform stored on a central server which is responsible for distributing the meeting content to all the other users connected; c) it allows the meeting to be carried out from any type of mobile terminal, thus increasing the portability and versatility of educational materials; d) the system has various tools that enable teacher interaction with students and interaction among the students. If necessary, it is also possible to share desktops, and, for example, the student can see how the teacher operates certain software. The session can be recorded in full or in part and then the system provides an URL so that students can watch the class again.

There are many reasons why universities are interested in incorporating video streaming in classes. Among those considered most important are:

- Increasing access to opportunities and flexibilization of learning (West, 2014);
- Encouraging written expression, as a way for students to communicate and share their own reasoning;
- Building a virtual learning community, since students not only learn from teachers but also from their peers;
- Strengthening certain characteristics of learning such as: constructiveness, since students must adapt new ideas to existing knowledge to make sense and meaning; intentionality, since students get involved in order to achieve cognitive goals actively and intentionally; collaboration and conversation, since learning is an inherently social and reflective process (Cabero and Gravan, 2005).

## 3. Methodology and development

An action research with certain elements of Grounded Theory is developed. The purpose here is to transform educational practices through a systematic process of learning supported by critical analysis of situations. The aim of Grounded Theory is to create or discover a theory restricted to a particular situation, linked to the context being studied. It uses the method of constant comparison and the classification into categories that are saturated as the information obtained is analyzed. Theoretical saturation refers to concepts and not to data (Alvarez-Gayou Jurgenson, 2006).

This research is a descriptive study because students' questions are analyzed and categorized considering how they express to manifest a certain difficulty in the respective theoretical framework. This is a longitudinal study, an analysis of the interests of students who attended the two courses which used this tool during the school year of 2015. The techniques used for analysis in this research process are document reading and network analysis. The study is performed considering survey questions and comments that students write down during videostreaming classes.

The population consists of one hundred and fifty students from two different terms in physics courses on b-Learning at the School of Engineering; and the sample was selected simply out of convenience. A secondary sample of eleven videostreaming sessions is also considered to measure the amount of contributions that are recorded per session. Two teachers from courses that are given in this university and an external researcher work in the coding process. Grounded Theory indicates how to develop the coding process and get saturated. The variable studied to carry out this analysis is the type of student's participation. The selected dimensions to characterize the type of participation are:

- Dimension I: Questions related to the content. It refers to the doubts expressed by students in relation to the theory, the model, or physical concepts.
- Dimension II: Students' explanations. These are contributions that arise spontaneously, related to the content of the problems to be solved, depending on the teacher's comments and other students´ questions.
- Dimension III: Questions about the context. These are comments that hinder the learning process, so they are classified according to their frequency.

Video streaming software allows the recording of an online class. Therefore, chat sessions are available for students to pose questions and comments. Figure 1 and Figure **2** show screenshots of a Physics class devoted to the resolution of problems.

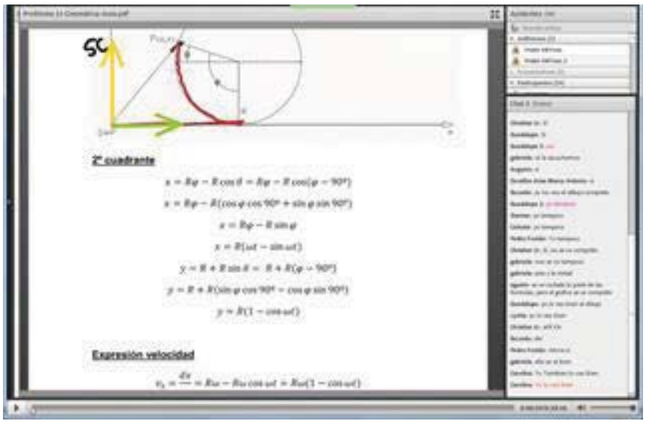


**Figure 1**: Screen capture 1 from Adobe Connect video

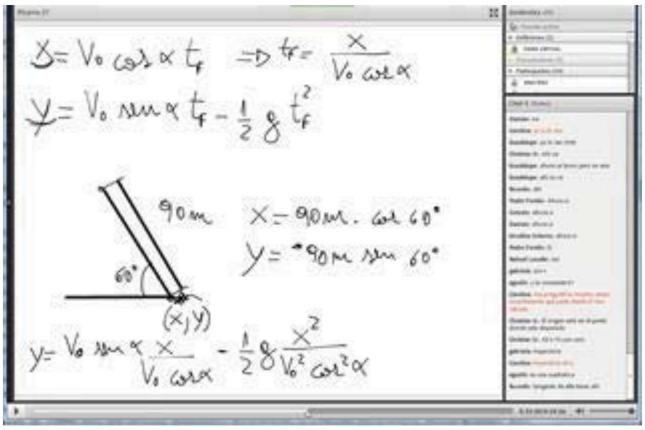

**Figure 2**: Screen capture 2 from Adobe Connect video

From the analysis of the records of student´s participation, the following categories were established in order to identify the type of participation and their characteristics. Students' comments were analyzed in the recorded video streaming sessions. When no new data or no new relationships appeared, the categories got saturated as shown in Table 1.

**Table 1:** Categories

| Unit of analysis: students | | | |
|---|---|---|---|
| Variable | Dimensions | Indicators | Categories |
| Type of participatio n | Questions about content | Conceptual doubts during the learning process | Lack of prior or background knowledge |
| | | | Difficulty in applying the conceptual framework |
| | | | Verification of the conceptual framework |
| | | Operational doubts | Difficulty in using reference systems and coordinate systems |
| | | | Arithmetic problems |
| | | Interpretation and representation of the problem | Difficulty in understanding statements / problem definition |
| | | | Symbolic notation |
| | | | Interpretation of figure analysis |
| | Students' explanations | Type of explanation | Exposition of their own examples / problems |
| | | | Integration of acquired content |
| | | | Collaborative construction of knowledge |
| | Questions about context | Type of comments | Problems to keep attention |
| | | | Lack of knowledge of study materials. |
| | | | Technical problems. |
| | | | Difficulties in reading the whiteboard. |

In Table 2, the different categories are exemplified.

**Table 2:** Examples of categories

| Indicators | Categories | Examples |
|---|---|---|
| Conceptual doubts during the learning process | Lack of prior or background knowledge | The teacher provides exercises dealing with content learnt in previous classes and asks students.<br>"What is the difference between normal and centripetal acceleration?" (Gustavo) |
| | Difficulty in applying the conceptual framework | In the resolution of an exercise with the physical expression of a quadratic function -topical ready learned in Calculus I-. A student said:<br>"I don't understand why the quadratic formula is not used." (Juan) |
| | Verification of the conceptual framework | "One question: when it leaves the circumference, doesn't it start to describe an oblique shot? For example the speed at that point is not null." (Julián) |
| Operational doubts | Difficulty in using reference systems and coordinate systems | A student asks (when a particle system example is solved):<br>"Ah, but then the reference system is to the other side?" (María) |
| | Arithmetic problems | The professor solves the following equation: $V_{R} . \sin\theta+V_{W}=0$. He clears the unknown variable in one step, and the students ask:<br>"Wouldn't it be divided?"(Lucas)<br>"But isn't it positive?" (Victor)<br>"Why is it subtracting? And negative?" (Julia) |

| Indicators | Categories | Examples |
|---|---|---|
| Interpretation and representation of the problem | Difficulty in understanding statements / problem definition | The problem asks for the value of the angle when a ship crosses a river with the maximum speed.<br>"Does the time calculated correspond to the maximum speed?" (Lucas) |
| | Symbolic notation | Along the resolution of a problem of mechanical wave.<br>"Is V the same as C?" (Juan) |
| | Interpretation of figure analysis | The professor makes a diagram that is different from the available in the Exercise Guide.<br>"Isn't it the other way around?" (Gustavo) |
| Type of explanation | Exposition of their own examples / problems | The problem shows a situation with the friction force.<br>"If there were no friction force between the carriage and the block, would they move?"(Gonzalo) |
| | Integration of acquired content | An exercise of Kinematics is being solved, students explain that it can be resolved in a different way.<br>"The problem can be solved with the theorem energy conservation". (Gonzalo) |
| | Collaborative construction of knowledge | A student asks a question during the resolution of a problem of relative movement "would that be the moment when they meet?" That is a trigger question since students start giving their answers until the right answer is accepted by the teacher:<br>"That's the time it takes for the projectile to reach the globe."(Juan)<br>"It is the time it would take to reach the globe if it were at the right height."(Pedro)<br>"But we must add the time it takes the balloon to get to that height."(Carlos)<br>"5 seconds before the balloon reaches that height." (Julia) |
| Type of comments | Problems to keep attention | Students fail to follow the resolutions:<br>"Are we calculating the speed in Y-axis direction?" (José) |
| | Lack of knowledge of study materials. | The teacher asks students to look at the table of physical constants that is in the practical guide.<br>"Where is the table?" (Julia) |
| | Technical problems. | "Teacher, some noise is heard and sound is distorted, I do not know if something it happens or if my computer is the problem" (Juan) |
| | Difficulties in reading the whiteboard. | The teacher writes on the screen the letters i and j, and students have problems to differentiate them.<br>"If you add two vectors j, the result should not be in j, should it?" (Pablo). |

It is observed that more than 60% of students got connected and participated depending on the topic of the class. Those classes dealing with more complicated problems and content collected more questions and comments from students trying to understand and expand their knowledge. Figure 3 illustrates the participation in the different Physics topics. It shows that there are more questions from students in topics as Particles Systems (31%) and Rigid Body (22%).

An analysis of their participation is carried out, which reveals the frequency of each category. The findings are shown below in a comparative chart of all dimensions (Figure 4). The category with the highest frequency (22%) corresponds to "Verification of the conceptual framework". The following categories are "Difficulties in using of reference systems and coordinate systems" (16%), "Difficulty in understanding statements/problems definition" (11%) and "Difficulty in applying the conceptual framework" (18%). 76% of students' questions refer to the first dimension of interest "Questions about content".

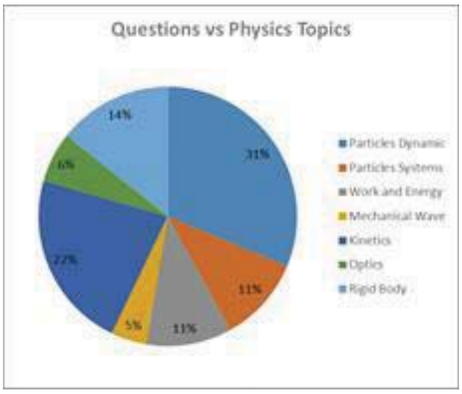


**Figure 3:** Contrastive analysis of questions and Physics topics

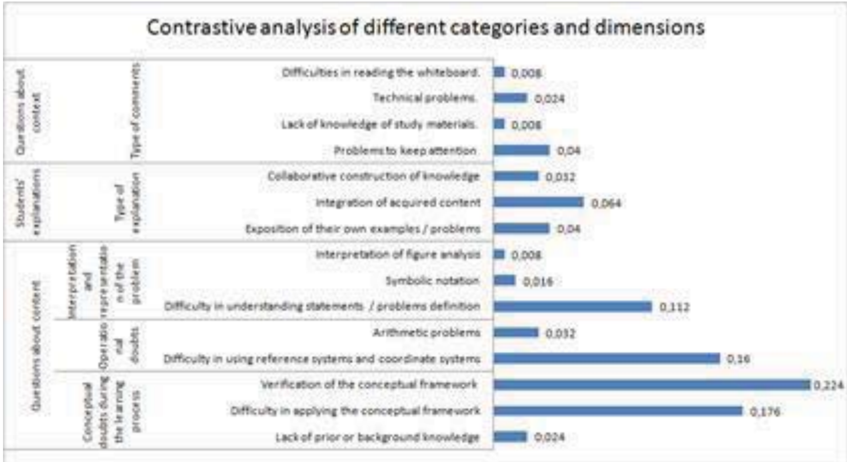


**Figure 4**: Contrastive analysis of different categories and dimensions

## 4. Conclusions

The degree of participation in non-compulsory videostreaming classes shows that such resource is relevant for students. The development of the online class enables students to solve problems with the guidance of the teacher and to clear their doubts at the time of the resolution. It is worth mentioning that students feel free to ask all kinds of questions, in contrast with the degree of participation in face-to-face classes, where they are afraid of “making mistakes”. Their identity is not threatened by their own misinterpretations, or lack of prior knowledge, etc. It is also remarkable how students build knowledge collaboratively through simultaneous participation, when they analyze the application of a scientific model, they justify some reasoning, or they interpret the validity of a procedure or a result.

According to the records of participation in the Moodle platform, it can be seen that the recorded online class is watched by more than 50% of the students who do not attend the class synchronously. Recording a live class enables other students not only to interpret the resolution of the teacher but to have access to other students´ questions, which may reflect their own doubts. Hence, this resource allows students to review preconceptions about the application of physical models and to correct mistakes.

It is observed that the category with the highest frequency corresponds to "Verification of the conceptual framework". Students continually ask questions to the teacher in order to verify if what they understand is correct. This shows great insecurity in the students´ own learning process. Other categories with high frequency correspond to "Difficulties in using of reference systems and coordinate systems" and "Understanding statements". The lack of proficiency in reading and understanding scientific texts in particular, is an obstacle to the interpretation of statements. It is also noted that students have difficulty in "Applying the conceptual framework" since they remember formulas but they do not know how to apply them in a specific context. The Physics topics that collected more questions from students and consequently registered the highest frequency are related to Particles Systems, and Rigid Body.

Videostreaming is a key resource for the Physics Class since it allows the interaction with a large number of students in a clear and precise manner, thus improving the form of communication of a face-to-face traditional class. In accordance with the selected theoretical framework, with this resource and the teacher's guidance, students apply more cognitive processes and engage more in problem analysis. On the other hand, teachers can monitor the learning process and evaluate or regulate the support and guidance they provide to students.

This precedent opens up the possibility to apply videostreaming in other courses of Physics subject as well as in other chairs, by blending various audiovisual media. It is important to bear in mind the need to implement ICT tools into university classrooms and to meet the growing demands for other modalities and other teaching strategies. It is also a challenge to train teachers in the use of synchronous resources and, in particular, in the proper use of video streaming. The increase in enrolment, as well as the uneven prior knowledge of the incoming students, poses many questions about the technical possibilities to reach more students and encourage flexible teaching and learning.

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# Investigating the Impact of Blended Learning on Learning English

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**Abstract:** The integration of blended learning in teaching English at The National School of Engineers of Tunis (ENIT), Tunisia through the introduction of a multimedia courseware (DynEd) in the curriculum, is hoped to improve the proficiency level of future engineers. This paper is a report on a case study focusing on the experience of implementing DynEd within the scope of the Support Programme for Quality (*QIP*) in education. The study focuses on ENIT PhD students taking DynEd courseware along with a blended learning situation. Empirical data consist in pre-test and post-test data from DynEd records manager. Moreover, a questionnaire is administered to tease out the students' perceptions of a blended learning course, the teachers' role and the synchronization of face-to-face class with DynEd courseware. The results will be used to illustrate aspects of the blended program outcomes and student's perceptions of the teaching methodology embedded in DynEd, the technological tools and the impact of the blended learning environment on their level. This study adopted statistical and quantitative analytical procedures for analysis. The results taken from DynEd record logs indicate that students' proficiency levels in English improved. This is supplemented by the personal reports which indicate that the students felt that they have improved at the level of fluency and accuracy. The paper ends with the study results and recommendations for further research and for teaching in a blended learning context.

**Keywords**: blended learning, courseware, progress reports, adaptive learning/assessment, perception

## 1. Introduction

The rapid global growth of computer use and technology advancement have aroused interest in the education sector to introduce Computer Assisted language Learning. Hubbard (2008) claims that technology has added a new whole dimension to various aspects and features of second language (L2) learning by requiring understanding, training and abilities for those who want to integrate it into their language teaching or see its effect on both the language teaching and learning. The integration of educational technology to enhance instruction progressively gained ground. In this context Chapelle (2003) argued that the connexion between technology and language may alter concepts in applied linguistics such as the notion of communicative language ability, grammar and register analysis, and the use of the teachers' accessible tools in class.

Both teachers and students can benefit from CALL especially when it matches the learners' changing needs in foreign language learning. Thus, several research studies have been conducted in this field (Gulbahar & Madran 2009; Lim & Morris 2009). These researchers' aim was to look at the effect of mixing e-learning and face-to-face instruction by implementing the Blended Learning approach. The findings of these studies show that creating a meaningful and applicable learning experience that enhances students' motivation is the backbone of a successful blended learning program. This is achievable by adopting of the adequate instructional blended strategy, deciding about the modality and purpose of instructional delivery and considering the learners different learning aptitudes, levels, styles and needs. In this respect, Chapelle (2003) claims that the advancements in technology-mediated tasks through the development of tasks, the doubting of existing task theories and the examination of the encountered or potential issues in teaching and learning can help prove the benefits of adopting the technology mediated learning through applied linguistics' theories, concepts, and aspects.

Over the past decades, English has emerged as the main language for international communication. It has spread all over the world and has become the global language since it is the language of sciences, technology and economy. For this reason it has become a necessity for the learners around the world to master the English language to be able to communicate and compete in the global market. Hence, advances in technology have gradually gained ground in education to significantly change teaching and learning methodologies and make them suit both the learners and teachers (Levy, 1997; Bax, 2003; Chapelle 20). This has a direct impact on the teaching of the four skills (Listening, Speaking, reading and writing), and the pedagogies and approaches adopted for language learning in and out of the classroom (Hockly, Dudeney and Pegrum, 2013).

The rapid growth of technology development helped expand its use in the language learning field to include different innovative practices such as the design of virtual learning environment, Web-based distance learning, introduction of interactive whiteboards, and collaborative tasks using Computer Mediated Communication

(CMC) tools (Beatty, 2003). In recent years, mobile technologies and smaller portable devices gave way to Mobile-Assisted Language Learning (MALL) and "Bring Your Own Device" strategies which helped extend learning outside the classroom (Chinnery, 2006 and Thorn 2003).

## 2. CALL in teaching and learning

A while ago, Bruce and Hogan (1998) claim that technology has become an unavoidable tool in education, therefore integrating technology with language teaching application should inspire language experts to find the appropriate way to apply technology in applied linguistics in general. Pennington (1996) supports the same idea as she considers CALL a powerful tool that offers learners a wide variety of a more focused comprehensible input and output that helps boost language learning process, develops learner's communicative competence and greatly optimizes teaching and learning. She considers that having an easy access to information through technology has a positive effect on the learner's psychology and productivity while acquiring the language. This motivates the learners to be more engaged and autonomous while experimenting and practising the language, for instance, communicating online, taking on a variety of voices and roles when interacting with other learners of the same L2 (Chapelle, 2008).

Similarly, Chapelle (2003) argues that (L2) acquisition can be improved by integrating technology in the design of CALL activities so that the cognitive and social processes are optimised to support language acquisition. The cognitive processes, which refer to knowledge acquisition and comprehension of the input through thoughts, experiences and senses, are influenced by intrinsic and extrinsic factors. These mental processes are directly linked to learning acquisition as they help learners understand the linguistic input and notice gaps between what they already know and their L2 output. This offers learners the necessary support, interaction and feedback to produce a more comprehensible output. Moreover, the social process emphasises the great value of the situation in which the processes take place through scaffolding and the development of the learner's identity (Chapelle 2003, Horn and Staker 2015).

## 3. Blended learning

E-learning refers to electronic learning and is defined as an educational tool that uses computers, computer assisted instructions and digital media (Keller, 2005). Though this has set the ground for virtual learning and greatly influenced English language teaching and learning it has then progressively paved the way to the development of blended learning concept in the 21st century. Blended learning combines e-learning multimedia advances with the traditional instructions in different modes to fit the learners' needs and styles and improve and enrich their learning experience (Thorne, 2003). Horn and Staker (2015) classify blended learning taxonomies into eight categories: (1) the Rotation Model, (2) the Station Rotation Model, (3) the Lab Rotation Model, (4) the Flipped Classroom Model, (5) the Individual Rotation Model, (6) the Flex Model, (7) A la Carte Model and (8) the Enriched Virtual Model. The online and mortar and brick courses as well as the teacher's role vary from one model to another. It is also possible to mix these approaches and models to suit the pedagogical objectives of the teacher, the policy adopted by the school and its infrastructure to tailor learning to the students' needs (Horn and Staker 2015 and Thorne, 2003).

Though blended learning represents, in principle, a practical and optimal innovative remedy to teaching minding the different levels, styles and needs of the learners, implementing it appropriately is a determining factor in its success. Setting up a blended system of instruction within an institution requires allocating a budget, a vision for the change, a firm commitment on the part of the administration availability of IT support and teacher training (Thorn, 2003). It also includes coping with many potential issues that may be encountered during the implementation process of a blended learning process. Obstacles that may be encountered include false assumptions and prejudices about this new approach of learning and provision of the adequate IT infrastructure to assist the online learning (Horn and Staker 2015 and Thorne, 2003).

In support of blended learning, Horn and Staker (2015), Thorne (2003) and Pennington (1996) emphasise the criteria for "successful" implementation of the different modes of bended learning programs. They claim that blended learning offers learners the opportunity to focus on their individual and specific learning needs rather than adopting a "one size fits all' solution that is intended to suit common learners' needs. Besides, the potential for personalisation, it also blends creative language construction and practice both online and in the face-to-face situations. The combination of the two help progressively develop learners' language knowledge and skills and improve their comprehension and production of the language as learners become more responsible for their own learning when working independently online. When working on the materials online, they have the possibility to monitor the e-content they are using as well as their progress, study rate and pace with which they wish to study. Horn and Staker (2015), state that shifting instruction and content online, helps students fill in their knowledge gaps since online learning assists students 'to know', the face-to-face class helps students 'to do and to be'. Face-to-face classes connect and correlate with what was learnt online by involving activities such as project based activities, group discussions and hands-on projects that help students 'dig deep' in their knowledge and become more engaged to deeply apply the skills they have acquired in several 'physical contexts'.

The teacher's role in a blended learning context is the key to ensure the success of CALL in general and especially in distance and blended learning situations (Horn and Staker, 2015 and Thorne, 2003). The teacher's role is no longer limited to that of a tutor or instructor. Rather, it shifted to being a facilitator and a coach who supports the learning process of the students by providing a personalized feedback (Derbel 2013, Horn and Staker, 2015 and Thorne, 2003). The teacher in a blended learning situation is required to keep track about each learner's online study and searching for the most efficient teaching means to link the online content to the face-to-face class in order to enhance learners' experience and help them meet their learning targets. Since they have a direct impact on the learners' motivation to work online, the teachers choose and adapt the most appropriate CALL application that suits their students' diverse needs and supports their teaching by connecting the online content to their face-to-face curriculum to enrich and deepen learning (Aborisade 2009, Horn and Staker, 2015 and Thorne, 2003).

Zapata and Sagarra (2007) searched the effect of online workbook and paper workbook on vocabulary acquisition among L2 learners in an American university during two semesters. The participants in this study had four hours of face-to-face class per week while at the same time they studied with an online or a paper workbook once a week. Students were assessed by taking vocabulary tests on computers. The findings of this research showed that students, who used online workbooks, studied for longer hours, acquired more vocabulary and had higher achievements than those who studied with a paper based workbooks. This was a proof of the efficiency of CALL in L2 vocabulary acquisition.

Aborisade (2009) investigated the blended learning program impact by integrating Moodle directory for 2000 students in the Federal University of Technology Akure, a low-resourced Nigerian university, to overcome the barriers encountered in teaching. Students accessed the online materials and communicated and collaborated online through group wiki and group discussion forums to post their assignments, get teacher's feedback, share ideas, work on group tasks and check their progress. However, the face-to-face class was devoted to brainstorming, debates and discusses with a team to boost communication. The results of this study showed that blended learning approach had a positive impact on learning and teaching as the students' proficiency levels improved, students became more autonomous and the study working rates increased. It supported teaching and learning, provided flexibility to both the teachers and students and offered a program that is pedagogically sound. This research also proved that the challenges in low resources institutions can be met with the motivation and willingness of both the teachers and the students to bridge the digital divide.

## 4. Methodology

DynEd courseware is a course developed by DynEd International etc. designed to be used in a blend with teachers and classroom support. The course is supported by a Records Management System, Mastery and Placement tests, extensive teacher-support materials and a teacher training course that helps teachers blend technology into their teaching and better understand the theoretical background and practice of DynEd. DynEd's courses cover all English proficiency levels that correlate with the Common European Frame work for languages (CEFR). This study was designed to examine the impact of DynEd courseware on adult students' proficiency level in an engineering school in Tunis, Tunisia (ENIT). As mentioned earlier, the aim of introducing DynEd is to help students improve their proficiency level in English. DynEd courseware was used with PhD students within the framework of the Tunisian Ministry of Higher Education Programme for Quality Assurance in education to improve the level of science students' English. Students took DynEd computer adaptive pre and post placement tests to determine their entry level and evaluate their progress at the end of the training. They had to study on the courseware for ten months for an average of 3 to 4 hours per week and attend a weekly one hour and a half face-to-face class to help them develop their communication and language skills. The teacher is meant to embed what was studied on DynEd courseware in lessons so that learners could reinforce and extend the language that they had learnt online in a real social context. DynEd application was installed on the students' personal computers and on the computers in the labs at ENIT. The students were expected to work on an average of 30-40 minutes per day for five to six days a week and to use the courseware effectively and vary their courses, lessons and activities during the same study session. These students had three orientation sessions on the courseware and were coached weekly by email by teachers, who were DynEd certified coaches.

A case study approach was used to focus on a group of adult students at ENIT who used DynEd as a core course in a blended learning program for ten months. A questionnaire and data from DynEd's Records were used to answer the following research questions:

- In what way does DynEd courseware usage reflect on the students' proficiency level ranking according to the EU frame of reference?
- What are the students' behaviours while studying on DynEd?
- How do students perceive DynEd courseware usage to learn English as a second language?

The case study approach can be implemented to better understand the use of technology by individual users, groups, and programs in blended learning situations (Grgurovic, 2011).

This case study involved two dimensions in the analysis by focusing on students' outcomes, perceptions and behaviours through the use of DynEd's Records Manager and a questionnaire that was delivered at the end of the training session.

The participants in this case study were 51 PhD students from different ENIT research laboratories and engineering fields, who used DynEd as an optional course during ten months at ENIT in the 2014-2015 academic year. The students joined on the basis first come first served as long as they were registered in one of ENIT research units and committed to regularly attend the weekly face-to-face class at the university.

Data of 51 students data were used in this research since 19 students dropped at the beginning or middle of the training for several reasons such as getting an unexpected training necessary for their research abroad or not being able to manage studying English while at the teaching and progressing on their thesis. These 19 students either only took the entry placement test or just worked little bit on the courseware during the couple first weeks. On this ground there was no way to evaluate the progress of these students. This blended course aimed at providing students with an intensive English course to be able to develop their language skills and improve their proficiency level.

## 4.1 Research instruments

### *4.1.1 DynEd placement tests*

DynEd adaptive Placement Test was administrated to all students as a pre and post-test. It is an adaptive placement test which varies in length and difficulty and automatically adjusts the difficulty of the test according to each student's responses. It focuses on listening comprehension, grammar and vocabulary and sentence-level comprehension. The test is made up of two parts and each part consists of 60-75 items. The test is ended once a student misses a significant number of questions at any stage. The Placement Test questions include multiple-choice items, listening comprehension, sentence construction, and sentence ordering items. DynEd Speaking Test and New Dynamic English confirmation Mastery Test were given after the placement test to confirm the students' placement level. The Speaking test includes sentence reading and repetition, comprehension and pronunciation items. The confirmation Mastery Test is an achievement test and consists of 20 to 50 items depending on the module or unit and the question types are the same as the Placement Test. If a gap is noticed in the results of the three given tests, the placement test needs to be given again to that student either the same day or before studying three hours on the courseware. This happens rarely and for this sample group only four students had to retake the Placement Test. Following the pre-test students are classified on the records manager on groups per proficiency level. At the end of the training all students took the post placement test, which is an achievement test that allows evaluation of the students' proficiency progress level in comparison with the pre-test situation. DynEd pre and post placement test scores are ranked on a scale of (0.0 – 3.5) and correlate with the CEFR (see Appendix 1).

*4.1.2 The questionnaire*

A Closed ended questionnaire made up of seventeen questions to elicit information on students' behaviours while using CALL and DynEd courseware and explore their perceptions of the technical tools and effect of a blended learning situation on the use of learning strategies, process and results (skills improvement and achievements). The questionnaire was piloted with 20 students which revealed that some questions had to be reformulated by using simpler language to suit all levels of proficiency.

## 5. Results

The aim of this case study is to investigate 51 PhD students' outcomes and perceptions of the experience of learning English with DynEd courseware in a blended learning program. Below an attempt will be made to answer the questions about whether DynEd courseware has a positive impact on ENIT PhD students' proficiency outcomes and students' behaviours on the courseware and their perceptions of it. Results from the records manager and the questionnaire are quantitatively analysed.

### 5.1 Students' achievements based on DynEd's records manager

The results of DynEd pre-test show that the students' proficiency levels at the beginning of the training ranged from A0 to B2. That is having scores between 0.0 and 2.7 (see Appendix 1) that correlate with the CEFR levels. The statistical analysis of these results revealed that the most frequently observed levels of the pre-test was A1 level with an observed frequency ($n$) of 35 (69%), which represents the majority of the students, while 14% had A0 level, 6% had B1 level and only 7% of them had a B2 level. However, the most frequently observed level of the post-test was B1 ($n$ = 19, 37%). These results show that there is a difference in comparison to the pre-test results (see Figure 1). First, it is noted that there is a sharp decline of both A0 and A1 level proportions, since no student had an A0 at the end of the training and the proportion of students with A2 level was 20%. In contrast, the percentage of students with A2 level slightly increased by 2% to reach 6%. Besides the figures underline the fact that the number of students reaching B1 and B2 levels increased quite significantly at the end of the training. The previous scores 6% and 7% reached 37% for B1 and 31% for B2. Moreover, the findings show a similar upward tendency of the C1 level as 6% of students reached a proficiency level of C1 (see Figure 1).

A paired samples $t$-test was conducted to examine whether the difference between the pre-test and post-test was significantly different from zero. The result of the paired samples $t$-test was significant, $t$ (50) = -13.66, $p$ < .001, suggesting that the true difference in the means of the pre-test and post-test was significantly different from zero (see *table.1*). The mean of the pre-test was ($M$ = 0.92) was significantly lower than the mean of the post-test ($M$ = 2.01). Cohen's $d$ was ($d$ = 1.57> 0.8), which reveals a substantial large effect size (see Figure 2).

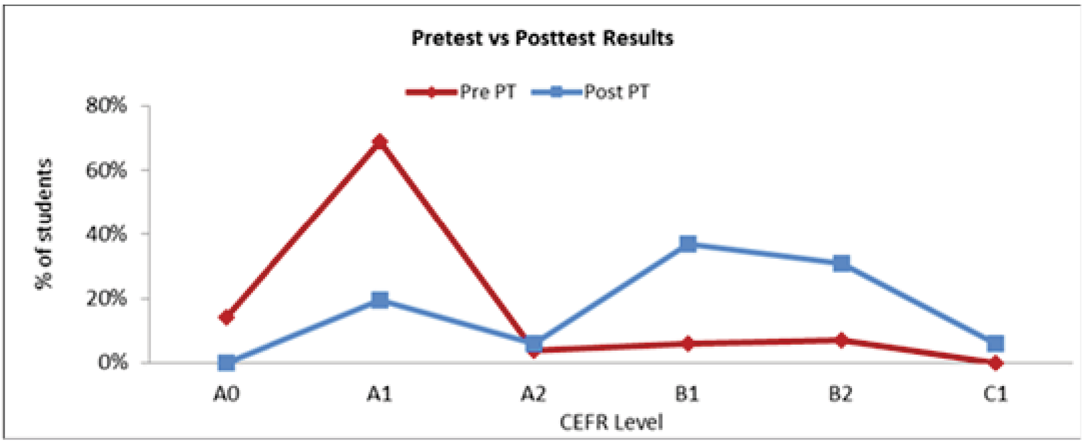


**Figure 1:** Comparison of students' DynEd pre-test and post-test results

**Table 1:** Results of the paired samples t-test for the difference between the pre-test and post-test

| Pre-test | | Post-test | | | | |
|---|---|---|---|---|---|---|
| ***M*** | ***SD*** | ***M*** | ***SD*** | ***t*** | ***P*** | **Cohen's *d*** |
| 0.92 | 0.67 | 2.01 | 0.71 | -13.66 | < .001 | 1.57 |

*Note.* Degrees of Freedom for the $t$-statistic = 50.

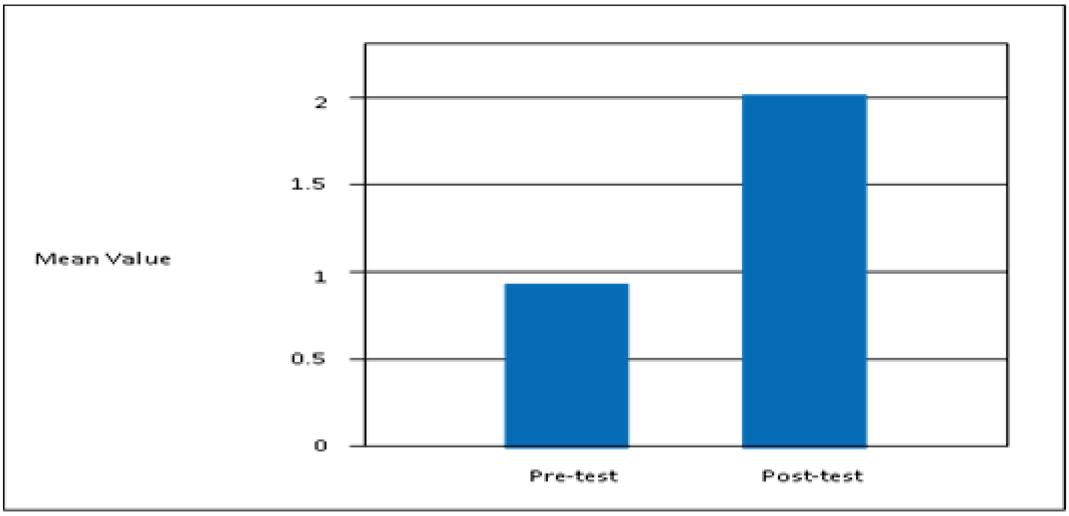


**Figure 2:** The means of the pre-test and post-test

The analysis across level shows that majority of students (35%) improved by two CEFR levels; 2% moved from A0 to A2 and 33% of the students moved from A1 to B1. The results also indicate that 22% of the students improved by three CEFR levels and moved from A 1 to B2, while 2% progressed by four CEFR levels and moved from A1 to C1. While 59% of the students progressed by two to four CEFR levels, 29% of them improved by one CEFR level and 12% didn't make any progress (see Figure 3).

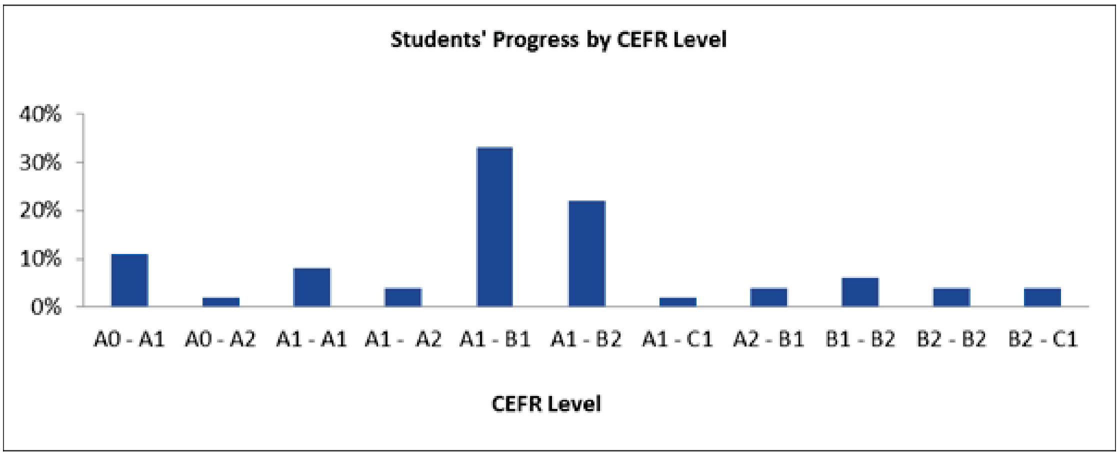


**Figure 3:** Gives a more detailed data about the students' proficiency level progress per CEFR level

## 5.2 Questionnaire findings

### *5.2.1 Students' perceptions of their skills improvement*

The first part of the questionnaire dealt with students' view of DynEd courseware and its impact on their four skills improvement. The satistical analysis of the data related to this point reveals that almost all students partly (21% - 36%) or totaly agreed (42% - 68%) that studying with DynEd courseware enabled them to improve their four skills in English (See *Figure.4*). A close focus on the results of students' responses shows that 9% percent agreed that their listening improved and only 5% who were neutral. Concerning the reading skill 7% agreed that the courseware helped them improve this skill while 2% were neutral. For the writing skill, which was enhanced through guided activities through the courseware, most students agreed, partly agreed or totally agreed that their writing skills were enhanced, except 2% who were neutral and 2% who disagreed. The overall results of the responses to these questions reveal that most students were enaged to improve their skills and feel the outcome of their work on the courseware.

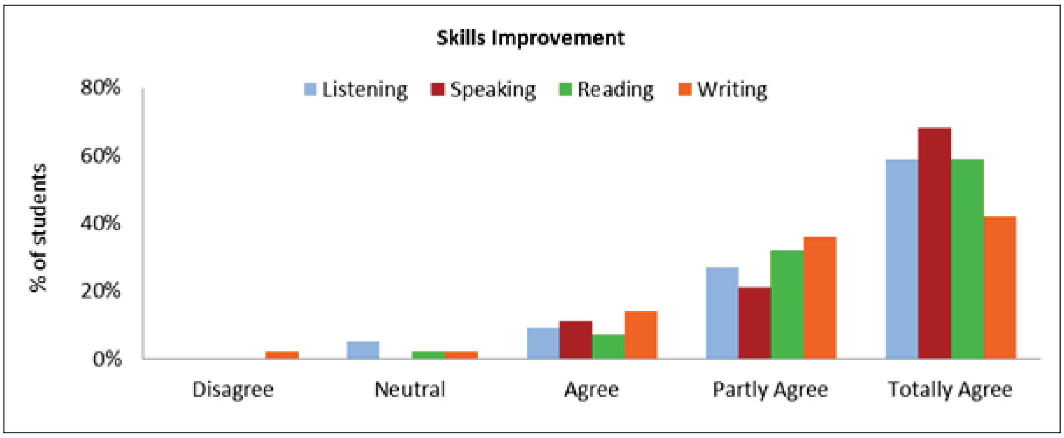


**Figure 4:** Students perception of their English skills improvement by using DynEd

*5.2.2 Students' behaviour when using the courseware*

The second part of the questionnaire was meant to reveal details from the participants about their use behaviours while studying with DynEd. The questions in this part searched students' use of the different courseware options that are intended to optimize students' learning (See Figure.5). The overall questionnaire responses show that the majority of students used the repeat, record, and headset buttons frequently while studying. 83% of the students reported that they used the repeat button every study session while 15% reported that they used it sometimes and 2% never used it. However, 34 to 66% of the participants used the voice recording and the headset buttons in every study session compared to 34 to 39% who sometimes used it. As for karaoke, that is repeating the sentence with the native model to improve pronunciation, intonation and automaticity, nearly 50% of the students reported that they used it regularly in contrast to 45% of them who said they used it "sometimes" but 7% of the students who never used it. The use of these options reveals that students were active while studying to enhance fluency and accuracy. In addition, speech recognition exercises in the form of fill-ins, sentence reading, answering questions, sentence repetition, speech quiz, inferences, simulations and video interactions, turned out to be very popular as 61% of the students reported that they used them in every study session compared to 39% who used them from time to time. This infers that students followed their teachers' instructions on how to study effectively and were active on the courseware to improve their fluency. For the ABC button usage, which allows the display of the audio transcript, 73% of the students claimed that they never used it while 27% of them used it sometimes. For the translation and glossary buttons, almost all students never used them (98 - 99%) (See Figure 5). These results show that learners underused these help options and relied more on listening for comprehension than on using the ABC, translation and glossary options. This reveals that students used the courseware effectively since they were encouraged to use these options when they repeat the same sentence several times and still could not understand it even from the context.

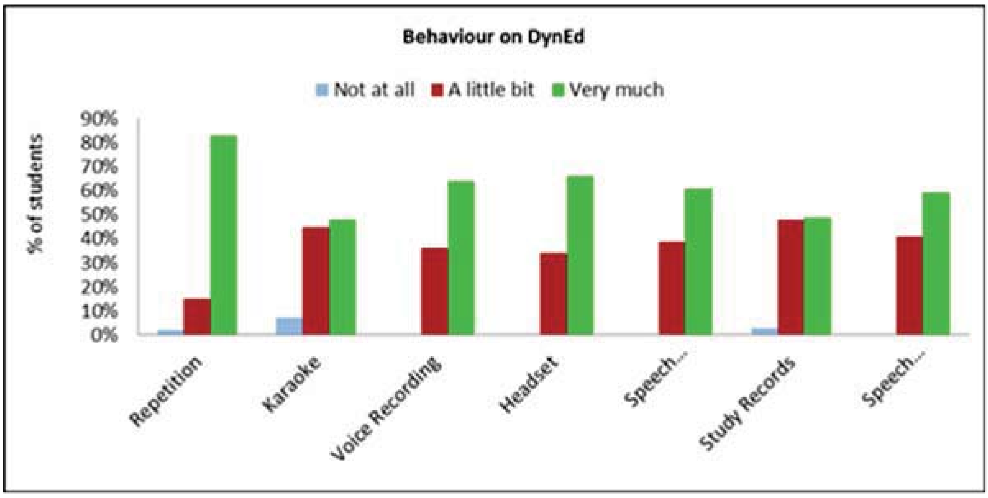


**Figure 5**: Students' self-reported behaviour while studying with DynEd courseware and their usage of DynEd options to acquire the language

*5.2.3 Students perception of DynEd activities*

The second part of the questionnaire dealt with students' view of DynEd courseware activities and their influence on the enhancement of their learning process (see Figure 6). 65% of the respondents think that DynEd activities were very engaging compared to 35% who feel that they are a little bit engaging. Concerning the question whether DynEd courseware offers a variety of activities or not, 90% of the students think that they were very much varied while only 10% see that it offers a little bit of diversity. Moreover, more than 70% of the students feel that the courseware helped them very much improve their grammar and vocabulary, while the rest thought that it helped them a little bit. Besides more than 80% of the students felt that studying with the courseware enabled them to improve very much their fluency and accuracy compared to less than 20% who thought that it helped them a little bit. This infers that most students were satisfied with the courseware activities.

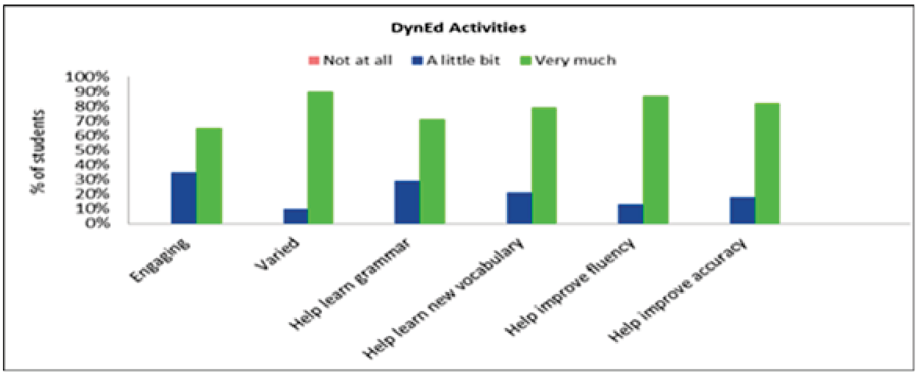


**Figure 6:** Students' perceptions of DynEd activities

*5.2.4 Students' perceptions of DynEd help options*

To investigate the usefulness and effectiveness of DynEd help options to assist students to study efficienctly, the third part of the questionnaire was devoted to focus on this issue. According to the responses of the participants more than 88% of the students think that the study records helped them control their studies and that both the help options and DynEd students' orientation videos were useful to guide them on how to study effectively. However only 7 to 12% of the students think that these options helped them a little bit (see Figure 7).

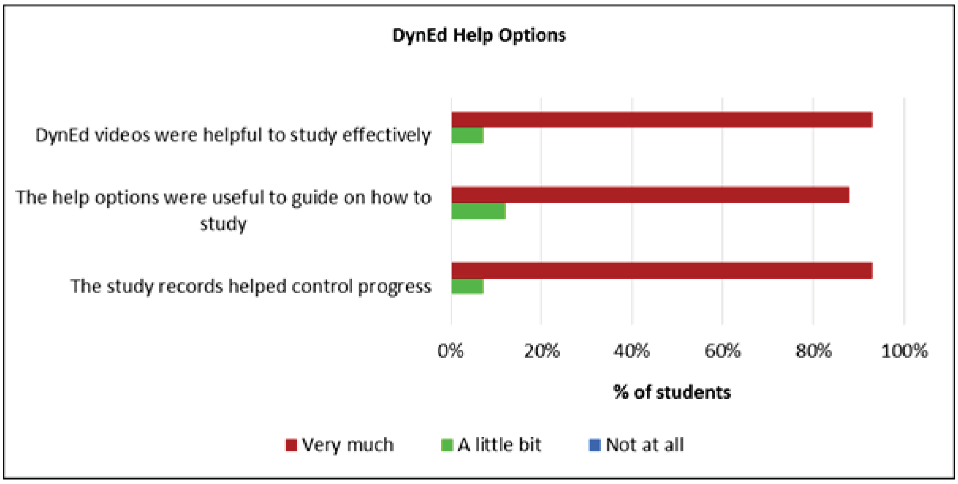


**Figure 7:** Students' perceptions of DynEd help options

The results of my data gathering collection that were presented in this chapter, show that students' perceptions of DynEd courseware and their behaviours in using it regarding language acquisition potential, learner fit and positive impact on their proficiency level gains were generally positive and in favour of the implementation of blended learning in teaching English with the support of DynEd courseware.

## 6. Conclusion

The overall results of the post-test in comparison with the pre-test proved that most students progressed and improved their proficiency levels depending on which CEFR level they started with. This was also confirmed with the participants' perceptions about the improvement of their language skills through the questionnaire results which were overall positive and supported the findings of the post-test. The students' behaviours on the courseware were also positive and showed that most students were active while studying through the use of the help and learning options that helped guide them on how to use program effectively and study efficiently.

## 7. Limitation of the study

As this study is limited to a small group of 51 ENIT PhD students, the data acquired from the study are considered to be limited to the improvement of the participants' proficiency level and their perceptions and behaviours of the participants in this research. Consequently the findings from this study may not be generalized. A bigger number of participants and a more qualitative measure of perceptions such as in-depth interviews could have enriched the results. This case study provided evidence of the improvement in test outcomes, behaviours and perceptions of a small group of PhD students at ENIT. Further studies should be conducted in different universities from different fields and with a larger sample group. This will enable to generalize results and better evaluate the program.

## Appendix 1: DynEd placement test score correlation with CEFR levels

| DynEd Placement Test Score | CEFR Level Correlation |
|---|---|
| 0.0 – 0.2 | A0 |
| 0.5 – 1.2 | A1 |
| 1.5 -1.7 | A2 |
| 2.0 – 2.2 | B1 |
| 2.5 – 2.7 | B2 |
| 3.0 | C1 |
| 3.5 | C2 |

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# Critical Reflective Practice in Digital Pedagogy: Embracing Creativity in Problem-Based Learning Environments

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**Abstract:** This paper is a qualitative narrative examination of undergraduate students' experiences in a fully online problem-based learning community. The author describes how three key elements interact - Creativity and Arts-Based Inquiry, Critical Reflection and Online PBL Community and then investigates Digital Moments as an example of best practice in developing high quality online learning environments. A community of 90 undergraduate students in three sections of 30 participated for 12 weeks in a blended course using flipped classroom video podcasts, online discussion boards using webKF, as well as weekly synchronous Adobe connect video conferences. Through this combination of modules, students developed their creativity and critical reflective skills within a problem-based learning online community. The theoretical framework is based on Brearley (2000) who explores the role of creativity in an academic context and Barone (2006) who focuses on arts-based qualitative inquiry and pedagogy. Further it refers to the works related to critical reflective practice of Griffin (2003), Hickson (2011) and Higgins (2011). The pivotal work of Schon (1987) as well as Greenwood's (1992) critique of Schon are included. Specifically, the paper describes how the PBL learning environment allowed factors to emerge that were necessary to develop a critical reflective community, and the transformative learning space that emerged by allowing students opportunities for creativity, intuition and greater self-direction. Using the concepts of "Digital Moments", students created Digital Narratives to describe their experience as adults in fully online learning communities. These digital stories were collected as artifacts including photos, artwork, musical selections and prose. Students' descriptive narratives of learning are chronicled in a problem-based learning digital environment. Best practices in digital pedagogy are explored through a qualitative account of the creativity, arts-based inquiry and critical reflective practice that have essential roles to inform online learning communities.

**Keywords:** critical reflective practice, creativity, digital pedagogy, problem-based learning

## 1. Introduction

In a digital age where online pedagogy and fully online communities are becoming the norm, educators are faced with the challenge to develop new and innovative pedagogical strategies. Given that the internet provides a myriad of ways for individual students to learn, the importance of critical reflective inquiry and creative constructivist learning environments becomes key. Davis (2009) argues that our pedagogy must change, that it isn't enough to simply add technology on to our already existing practices; we must infuse it throughout, just as it is fully integrated into the daily experiences of individual students and teachers. She reiterates that, "Teaching with technology is not just about how to use the hardware and the software, but is also very much about people, processes and a range of different interactions" (p. 149). Voogt, Erstad, Dede and Mishra agree that there are "key challenges for learning and schooling due to social and cultural changes happening across the world" (2013, p. 403) and that advances in technology "have created jobs that did not exist a decade ago, and young people need to be educated for careers that do not yet exist" (2013, p. 403). Several authors concur that learning in the digital world is "transforming what it means to work, study, research, express oneself, perhaps even to think" (Littlejohn, Beetham & McGill, 2012, p. 547).

To prepare for such a brave new world, educators need to emphasize the skills of critical reflection, provide avenues for the development of innovation and creativity, and learning spaces where students can individually and collectively develop key competencies for the 21C. "Creativity and innovation skills are especially important in today's economy" (Kaufman, 2013, p. 79) and educators must allow for "activities that foster creative thought, imagination and innovation at school, exercising students' minds in these areas, engaging students in practicing a critical and much needed skill set" (Kaufman, 2013, p. 79).

The central questions of this paper include 1. What is the role of Creativity and Arts-Based Inquiry in Online Problem-Based Learning environments? and 2. How can Critical Reflection be used through Digital Moments to develop creative and authentic fully online communities?

## 2. Theoretical framework

This research is based on the work of several authors. First, the role of creativity in academia is examined by Brearley who states "Who we are changes what we write about and how we write. Simply stated, if the academy is to change, if our views of reality are to be more inclusive, then we need to take a broader view of authorial voices" (p. 1, 2002). This aligns with the work of Atkinson and Claxton (2000) who discuss the value of creative thinking and of not always knowing what one is doing, as well as the notion that intuition has a place in meaningful knowing. The author argues that in digital spaces, these concepts of meaningful learning and of creative and collaborative co-design of learning tasks are essential to 21C pedagogy. An additional pillar for this work rests with Kaufman (2013), Littlejohn et al (2012), Voogt et al (2012) who discuss the changing digital landscape and the need for 21C skills such as innovation, creativity and problem solving. Finally, the author discusses how a problem-based learning environment can create a digital space where innovation and creativity can emerge as individuals collaborate, challenge and provide critical reflective feedback to one another.


**Figure 1:** Elements of creative critically reflective online space

## 3. Methodology

This paper follows qualitative methodology and is grounded in arts-based inquiry and the theoretical framework that knowing through the arts has both meaning and importance (Eisner, 1997; Eisner, 1998; Barone & Eisner,1997). It is also based on a foundation of critical reflection (Schon, 1987) and the role of social collective reflection (Greenwood, 1993)

*Description of Digital Moments as a Pedagogical Initiative*: The pedagogical structure of the course was focused on Problem Based Learning, allowing open-ended, ill-structured and student-centred tasks and activities. At the beginning of each class, students contributed a Digital Moment to the open pods available in Adobe connect, a webcam browser based digital tool. In a 60 minute class this process took approximately 5 minutes, with students sharing arts-based emotive expressions such as photos, personal art, music, quotations or images that indicated to others the issues/ problems they were facing, and their affective state as expressed through some personal artifacts. This Digital Moment was shared in the online community at the start or end of class, and took the role of collective critical reflection. This tool was a successful element in creating an environment rich in social capital and effective for problem-based pedagogy.

*Phase One:* .90 undergraduate students in three sections of 30 participated for 12 weeks in a blended course using flipped classroom video podcasts, online discussion boards using webKF, as well as weekly synchronous Adobe connect video conferences. Each week students watched 45 minutes of You-tube videos in preparation for a weekly 50 minute synchronous online tutorial session. Digital Moments were shared and collected each week and stored on the university secure server. Researchers recorded all Adobe connect sessions and stored the recordings on a secure server that was password protected

*Phase Two:* Recordings were analyzed blindly by two researchers independently and searched for key words related to each theme including: Creativity and Critical Reflection, Arts-Based Inquiry and Online PBL Community. Recordings related to each of these themes were placed in separate files and transcribed. These transcriptions were then coded and the researchers met to discuss notes and observations.

*Phase Three:* Researchers used the chat room feature of Adobe connect and automatically emailed the chat to all participants including the researchers each week for 12 weeks. Chat room discussion were analyzed for key words related to each theme including: Creativity and Arts-Based Inquiry, Critical Reflection, and Online PBL Community. Any additional themes that did not fit these areas were coded as minor themes.

*Phase Four:* During the final class, an open discussion and focus group was held to articulate how students felt about each of the three main elements. Students answered a poll with numerical rankings to rate the class overall based on their own experience of each of the three main themes as compared to other online courses they had taken at the same institution. Finally, students were invited to discuss the minor themes that had emerged from the chat room discussion recordings.

## 4. Data collection and analysis

The university ethical review was passed and students signed informed consent forms prior to taking the course. Students who did not choose to participate were still able to take the course and participate in the creation of Digital Moments each week. Informed consent stated that students would have no payment for participating and they had the right to withdraw at any time without academic penalty. All audio recordings of Adobe classes, chat room data and the final focus group discussion were transcribed and stored. All Digital Moment artifacts were stored in the format presented by students so that each student had a folder for their own DMs (jpeg, youtube clip, quote, prose) over the entire course. The recordings and Digital Moments were available for all students to review during the 12 weeks of the course but stored securely with access only by the researcher once the course had ended. Anecdotal comments written in the Adobe chat room were copied and stored securely. These comments were analyzed thematically and data was segmented to reveal comments that fit with each of the themes: Creativity and Arts-Based Inquiry, Critical Reflection, and Online PBL Communities. Once reviewed, the researchers identified further minor themes that emerged through analysis of the chat room text. A final class included students rating the class on a poll based on the three main themes as compared to other experiences with online courses they had taken. Of the 90 students, 78 responded to the poll. These 78 students rated the effectiveness of the learning experience on a Likert scale, (strongly agree to strongly disagree) based on Creativity and Arts-Based Inquiry, Critical Reflection and Quality of Online PBL Community. 68/78 students found the course to be above average in terms of these three main themes as compared to other online courses they had taken.

| |
|---|
| This was my last course of my degree and I wish I had taken this reflective course earlier in the program so I understood how important it is to reflect with colleagues. |
| I loved sharing my story each week. |
| Investing that time up front doing Digital Moments really helped us build our community. |
| I really took time to select my DM each week and looked forward to hearing others' comments. |
| This helped me to know how much our outside lives, kids, family responsibilities affect our concentration and focus as adult learners. |
| I felt I really got to know people in this course. |
| I have had some of these same students in other classes but I didn't even know their names so it really showed me how well this works to build relationships in online classes. |
| So much more personal than a MOOC I took last year. |
| I started using Digital Moments with my grade 5 class on smart board and they love it. It helps me know where the kids are at in an artistic way so they don't have to name their feelings, they can show me. That helps some of my needy students to participate. |
| I learned a lot about how important it is to have a place in class, to be listened to and to support other people. |
| I am an artist and I loved the way we could use paintings as our DMs. |
| It was my first online class and I didn't think I would get to know anyone but I really did, especially in breakout rooms as I was more comfortable talking in the small group. |
| This type of learning really suits my lifestyle and being a host in Adobe made us all feel responsible for the class. |
| There was a lot more participation with peers in this class which I enjoyed rather than listening to a lecture. |
| We started to connect outside class and I still tweet or Facebook some of my colleagues. |
| I love that Adobe Connect gives me the opportunity to connect with others and to share our thoughts and personal experiences in a safe and open environment. This makes it easier for me to share my thoughts without the fear of being judged or ridiculed as everyone is going through this learning process with me and sharing in the same struggles. With this type of environment I feel more comfortable and I am able to understand differences of opinion much more easily |
| Being a part of a learning community where students feel safe to take risks and share their thinking is paramount to my personal success and satisfaction as a student. |

**Figure 2**: Sample student comments

## 5. Key findings

### 5.1 Creativity and critical reflection in online classes

Creative expression through technology is seen all around us, and one only has to look towards You-tube, Vines and the ever changing world of social media that students and teachers use to create new knowledge. As seen by the student comments above, creative production pedagogy, with learners as creators, suggests an engaging future direction for online learning**.** In order to do so, students need to collaboratively and individually learn the skills to reflect on their own work and that of their peers. Schon (1987) refers to the use of reflection-in-action as a tool for the development of expertise. Greenwood (1993) challenged Schon's work to take it a step further to include the important social aspects of critical and creative reflection. These two habits of mind are essential as the problems which may arise in learning to teach with digital pedagogy are often those that the practitioner has never before faced. "The problems of real world practice do not present themselves to practitioners as well-formed structures; indeed, they tend not to present themselves as problems at all but as messy, indeterminate situations" (Schon, 1987, p. 4). Both students and teachers in new online learning environments must master the skill of reflection in order to adjust practice, modify the learning environment, and discover what works best. Several students commented that they wished they had taken the reflective practice course earlier on in their degree so that they would have developed the skill to reflect and also begin to value it as an important element of learning. Thus, reflection-in-action would seem to be a necessary skill for teaching well online. It is "central to the artistry with which practitioners sometimes make sense of uncertain, unique or conflicted situations" (Schon, 1987, p. 35). Reflection and contemplation become even more central to an online learning environment because of our dependence on the rational aspects of technology. "The university is dominated by the culture of technology and has become a centre for the production, transmission and storage of information. Higher education and teacher education have become departmentalized, specialized and fragmented. Students and professors seem at a loss as to how to connect information, concepts, and meanings. More important, there seems to be a gulf between the subjects and the inner life of the student. Contemplation can bridge that gap" (Miller, 1994, p. 132).

### 5.2 Arts-based inquiry in digital environments

Pedagogy that is grounded in arts-based inquiry argues that knowing through the arts has both meaning and importance (Eisner, 1997; Eisner, 1998; Barone 2006). In developing an online community, we have used Adobe connect which allows only for webcams for individuals to express themselves. By allowing students to start each class by sharing a Digital Moment with an image, picture or personal expression, the Arts becomes an important and critical element in creating community. It immediately sets the tone that creative and artistic thought are welcome, and that there is no fear of making a mistake, or fear of being graded on our contribution to the community. This avenue may cause pause for some educators, fearing that students would not 'buy in' to the process if the activity was not graded. In reality, the opposite occurred. Students had to unpack their notion of teacher as grader and student as receiver, and this set a tone of camaraderie both within and outside the course. Several students started their own Facebook page for the course and continued to communicate through social media such as Twitter once the course had ended. With this high level of social capital, community members got to know one another very well, and as a result of the more personal connection, students committed to each other, to themselves, and to a high standard of work. As one student stated, "this course had a higher level of social capital than any other online course I have taken. I really got to know my peers and felt I worked more effectively with them because I knew them more personally. It made the course a lot more engaging". While some educators may argue that fun and play do not have a place in academia, this author argues that many of our greatest innovations have emerged from creative exploration and numerous mistakes that occur in positive social and playful contexts. As such, using arts-based strategies such as Digital Moments creates a community of learners who take risks and support one another, thereby coming up with original thoughts and ideas that they may never have come to by taking a traditional "distance education" course where learners often feel isolated or alone.

### 5.3 Online community: Problem-based learning as a vehicle for transformation

According to Savin-Baden (2007), key elements of a problem-based learning environment include the following significant characteristics: 1. Complex real world situations that have no one 'right' answer are the organizing focus for learning. 2. Students work in teams to confront the problem, to identify learning gaps, and to develop viable solutions.3. Students gain new information through self-directed learning. 4. Staff act as facilitators 5.

Problems lead to the development of clinical problem-solving capabilities. In parallel to this style of student-centred PBL, are the set of outcome competencies that have been proposed by the Conference Board of Canada Employability Skills 2000+ (Conference Board of Canada, 2000). These 21C skills include (a) Fundamental Skills (the ability to communicate, manage information, think and solve problems, and use numbers), (b) Teamwork Skills (the ability to work with others and participate in projects and tasks), and (c) Personal Management Skills (the ability to learn continuously, demonstrate positive attitudes and behaviors, be responsible, be adaptable and work safely). These align clearly with some of the elements that surround a problem-based learning pedagogy. Students had initial resistance to the use of PBL in each of the three sections, predictably because this is not the kind of learning environment that they had traditionally experienced in their elementary and secondary school settings. As one student stated “I had a hard time getting used to the fact that there wasn’t a rubric for every assignment and I had to work with the instructor to develop my success criteria”. Focused on examinations and grades, many students exhibited some frustration at the lack of rigid criteria and specific directions for assignments. Another student reiterated that she “found it very frustrating as I am normally motivated by grades, so to have to bring my own ideas into it was really hard at first”. In contrast, PBL offered them multiple avenues to design assignments in different modalities that allowed the opportunity for collaborative ingenuity, ‘design as you go’ frameworks and many acceptable outcomes. Students were included in the definition of the assignment criteria by which their work would be assessed, by the instructor, by their peers, and by themselves. For students new to this approach, they struggled but slowly adapted, and for those who had taken this type of course, they embraced it wholeheartedly. PBL environments stretch far beyond marks as the final outcome of a course, and we need to move beyond grades to visualize new ways for students to connect and learn socially through technology. (Badge, Saunders & Cann, 2012).

## 6. Conclusions

Clearly, creativity needs to become adopted as a valuable part of academia and higher education. Griffin (2003), Hickson (2011) and Higgins (2011) all make the connection between critical reflection, the process of learning to be reflective and the use of critical incidents to promote reflection. In this paper, the author has described the creation of a fully online PBL community that enabled students to reflect and use arts-based methods to express themselves creatively. Overall, it empowered students to express their voices and to take control of their learning through problem based settings, inspired by the innovative climate that supports a variety of diverse outcomes.

In a digital world, there can no longer be one unique way of knowing about any one situation. We see things not as they are but as we are. Thus, valuing intuition and creativity can add to the rich and valuable outcomes of a problem-based learning environment. As Claxton (2000) observes, “teaching is a highly specific process but one which nevertheless has similarities with others involving the performance of complex and diverse skills in real time and in contexts that are unpredictable and constantly evolving” (p. 4).

The combination of variables and pedagogical initiatives such as Digital Moments instantaneously affect the quality of the learning environment. Educators in online communities should make pedagogical decisions based not on their own content knowledge, but by co-designing the learning tasks with other learners and incorporating student voices into the process. This may entail a certain amount of intuition born from inner knowing of the students as people in a social environment. Ferguson (1980) speaks about the type of inner knowledge this entails.

> *Paradoxically, if we give up the need for certainty in terms of control and fixed answers, we are compensated by a different kind of certainty, a direction, not a fact. We begin to trust intuition, whole-brain knowing, what scientist-philosopher Michael Polanyi termed “tacit knowing”. (p. 107)*

It is ironic that education has a long history of distrusting intuition. This may be a very unfortunate situation, since this arts-based qualitative research indicates that intuition is essential to successful PBL online communities. We have, as a culture, learned to distrust intuition and our online classes must include creativity and intuition as an important reservoir of professional knowledge. Claxton (2000) discusses the cultural value judgements placed on cognition as a higher order of knowing than aesthetics and intuition.

> *The distrust of intuition and the inability to see how and even perhaps why it could be incorporated into education reflect three hundred years of European cultural history. The Enlightenment picked out just this single way of knowing and, in raising it to a high art, implicitly ignored or disabled*

> *others: those that were not so clinical and cognitive and were instead more bodily, sensory, affective, mythic or aesthetic, in a word, intuitive. (p. 32)*

Perhaps it is time that educators embrace uncertainty. Instead of keeping our knowledge safely walled up in the institution, we might bravely step into the digital world NOT knowing, trying new elements in our pedagogy such as PBL, and using arts-based approaches to creating online communities that will help us improve the quality of digital learning environments. This creative and intuitive approach to online learning can help all students and teachers successfully navigate through the digital landscape, emerging unscathed with a few inevitable bumps and bruises, but with innovation and ideas that may have never otherwise emerged.

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# Authentic Storytelling in a Blended Learning Environment

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**Abstract:** Engaging students in a blended learning environment can take many formats. Amongst them are collaborative projects that are based on real experiences. Authentic stories should center on a common theme, in our case cross-cultural encounters. The objective was to teach the concepts of cultural intelligence and cultural distance in an innovative way. Six classes of an Executive MBA programme had to create authentic stories and illustrate them by means of animation or other forms of digitalisation. In total 202 digital stories were analysed in our research. We looked at the technical implementation and also at the content in form of participating cultures, gender, theories and outcomes. The stories were accompanied by a questionnaire to assess the characters (actors) of the story. It was based on relevant cross-cultural and negotiation frameworks in order to guide the discussion of the results in a meaningful direction. The analysis of the outcomes, which served as starting point for online class discussion, suggest that cultural intelligence in form of willingness to adjust during a negotiation is a predictor for a successful outcome. Even more important is a humane orientation which can also be described as relationship or affiliation with attributes such as modesty and caring. Performance orientation is the strongest predictor of all. From a technical perspective, findings suggest that social networking platforms are more suitable than standard LMS for communication. Students rated the usefulness of the authentic project for their learning on average as 6.7 on a scale 1-7. At the end of our paper we suggest 'Sequence and Timeframe' of such project.

**Keywords:** authentic storytelling, blended learning, cultural distance, cultural intelligence

## 1. Introduction

### 1.1 Blended learning

Blended learning research deals mainly with the best practices of combining face-to-face interaction with virtual add-on components (Graham & Gibbons, 2014; Keengwe & Kang, 2011; Power, 2008; Stacey & Gerbic, 2009; Tsai & Tsai, 2011). From a delivery perspective one can divide the modes into four sections, see Figure 1.

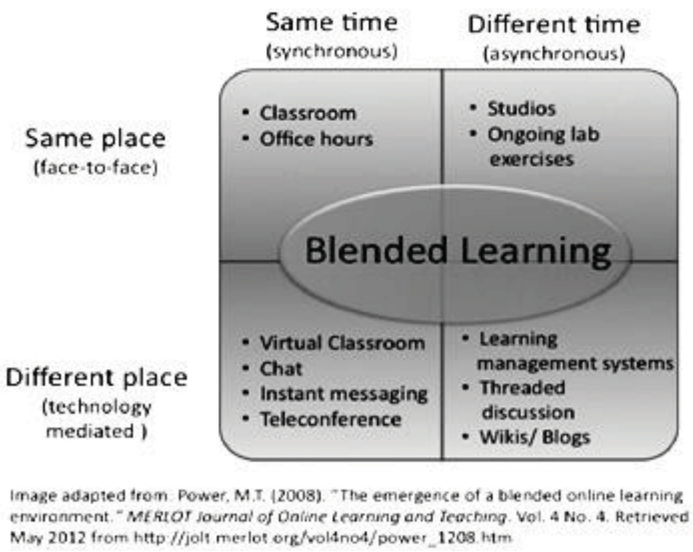


**Figure 1:** Delivery modes, taken from: Heckman et al. 2015

Most activities still happen in quadrant four powered by Learning Management Systems (LMS) (Graham & Gibbons, 2014). Gartner Group (2008) stated that LMS providers have focused on adding more and more functionality to their platforms and neglected that the LMS does not directly contribute to learning outcomes; instead, the tutors' feedback, interactivity, and adaptation of content, and students' personality are the determining factors of success (Kember, McNaught, Chong, Lam, & Cheng, 2010). Such a student-centered model recognises the value of *all* types of interaction including informal chats between students. It "integrates seemingly opposite approaches, such as formal and informal learning, face-to-face and online experiences, directed paths and reliance on self-direction, and digital references and collegial connections, in order to achieve individual and organizational goals" (Rossett & Frazee, 2006, p. 2).

The informal learning features that LMSs lack can be compensated by other solutions, e.g., Elgg, a social network engine, but there is no smooth integration. Location awareness is another important feature that's missing in all major LMS (e.g., Moodle and Blackboard). Students may want to send pictures to their peers close by or make other use of Global Position System (GPS). Being in reach of a fast network, a video download can be done whereas slow bandwidth would imply reading the text according to a location aware recommender system. However, even if the technical problem is solved the content issue remains because most content is not location tagged. On the content-side, instructors will have to embrace all other possible resources such as MOOCs and free learning resources e.g., CodeAcademy, iTunes U, Youtube etc. to make the learning experience more exciting.

## 1.2 Authentic storytelling

Authentic storytelling is a set of digital storytelling in the sense that the stories actually happened in real life. Digital storytelling relies on multimedia devices (Hartley and McWilliam, 2009). According to Lambert (2009), digital stories can reference different types of moments in a storyteller's life. They can deal with instances about people, events or places. Storytelling has been a pedagogical tool since the beginning of mankind. However, digital storytelling is more than a digital reincarnation of oral storytelling. It allows people to add images, music, sound, or a combination of media into a learning experience (Shuyan and Hong, 2010). Digital storytelling can enhance the educational process because it provides a vehicle for combining digital media with innovative teaching and learning practices (Smeda et al., 2010). Digital stories can also be used as assessment technique in an online or blended learning environment (Larkin and Beatson, 2014).

Executive MBA students differ from traditional full-time MBA students in aspects such as learning expectation, motivation, and internationalisation (Petit, 2011). With many years of work experience they are in a position to contribute their own authentic stories to foster collaborative learning. However, their attention span can be short and lecturing needs to be engaging. One tool of engagement is digital storytelling. In the context of a cross-cultural management course it can serve as visualisation tool of real cross-cultural encounters such as negotiations. Real-life face-to-face encounters can be taped as videos or represented in the form of digital stories. Due to privacy reasons it is problematic to record meetings. The risk of being publicised on youtube is just too high. An alternative is an authentic digital story that participants produce after the event and use pseudonyms for the actors. Such stories reflect the remembered experience of the participants; as such they are subjective.

## 1.3 Measuring cultural distance and intelligence

In cross-cultural management there are six major frameworks to measure cultural distance:

The first is Hofstede (1991) which has been the most widely used and criticised (Hofstede, 2001). Related to this perspective is Project GLOBE which followed a different approach in methodology and sampling but with similar categories (House, Hanges, Javidan, Dorfman, and Gupta 2004). Trompenaars and Hampden-Turner (2004) represents a third approach which is based on executive participants in international management development programs responding to value dilemmas. The fourth approach is the Schwartz Value Survey (1992) which covers values in many countries based on representative respondents. A more qualitative approach is the distinction between high and low context cultures. According to Hall (1976) East-Asia (e.g. Japan) would represent a typically high context culture whereas Europe and the U.S.A. are low-context cultures. Higher context cultures generally have a stronger sense of group orientation, seniority, unspoken rules, and tradition (Hall, 1976). Finally, Triandis (2001) looked at Individualism vs. Collectivism. As one can judge from Table 1, there are many overlaps and communalities between authors. In fact, all six frameworks are compatible although having used different research approaches.

**Table 1:** Cultural dimensions

| Dimension/Author | GLOBE | Hall | Hofstede | Schwartz | Triandis | Trompenaars |
|---|---|---|---|---|---|---|
| Achievement | | | | X | | X |
| Ascription | | | | | | X |

| Dimension/Author | GLOBE | Hall | Hofstede | Schwartz | Triandis | Trompenaars |
|---|---|---|---|---|---|---|
| Assertiveness | X | | | | | |
| Benevolence | | | | X | | |
| Collectivism | X | | X | | X | X |
| Communitarism | | | | | | X |
| Conformity | | | | X | | |
| Confucian | | | X | | | |
| Diffuse | | | | | | X |
| Emotional | | | | | | X |
| Femininity | | | X | | | |
| Future orientation | X | | | | | |
| Gender differentiation | X | | | | | |
| Hedonism | | | | X | | |
| High context | | X | | | | |
| Humane orientation | X | | | | | |
| Individualism | X | | X | | X | X |
| Indulgence | | | X | | | |
| In-group | X | | | | | |
| Low context | | X | | | | |
| Masculinity | | | X | | | |
| Neutral | | | | | | X |
| Particularism | | | | | | X |
| Performance orientation | X | | | | | |
| Power | | | | X | | |
| Power distance | X | | X | | | |
| Restraint | | | X | | | |
| Security | | | | X | | |
| Self-Direction | | | | X | | |
| Societal | X | | | | | |
| Specific | | | | | | X |
| Stimulation | | | | X | | |
| Time Orientation | | | X | | | X |
| Tradition | | | | X | | |
| Uncertainty avoidance | X | | X | | | |
| Universalism | | | | X | | X |

For example, the dimension ‘Collectivism’ to describe a culture has been used by four authors so its opposite ‘Individualism.’

Cultural Intelligence (CQ) is defined as an individual’s capability to adapt effectively to situations of cultural diversity (Earley and Ang, 2003). These are potential predictors for intercultural negotiation effectiveness specified as the final outcome of the interaction of the partners involved (Thompson, 1998). Negotiators achieve significantly less joint profit when negotiating across cultures than when negotiating within their own culture (Adler and Graham, 1989).

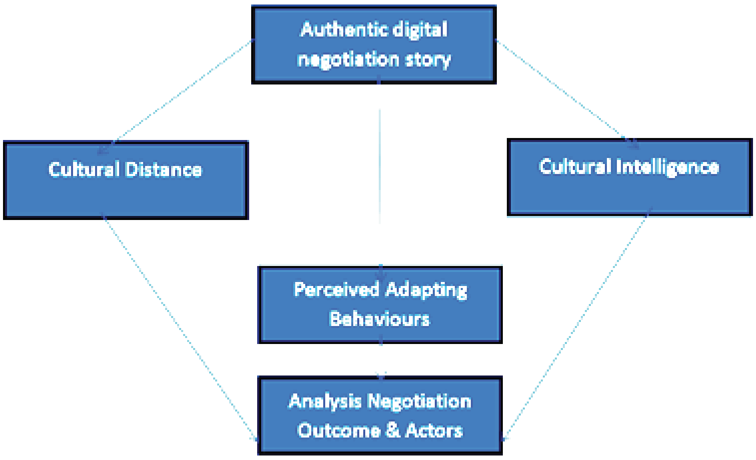


**Figure 2:** Research framework of negotiation

Authentic stories were the starting point of our research, see Figure 2. Our hypotheses were:

> *H1: The lower the Cultural Distance (CD) between the negotiators the better the negotiation outcome*
>
> *H2: The higher the Cultural Intelligence (CQ) the better the negotiation outcome*

This paper looks more into how this topic features in the learning process and less into the actual cross-cultural research methodology. Nonetheless, one has to understand the theoretical concepts to appreciate how students translated it into their own authentic stories.

Research Questions were:

- Does CD have an impact on negotiation outcome?
- Does CQ have an impact on negotiation outcome?
- Does adaptive behavior have an impact on negotiation outcome?
- Can CD and CQ predict negotiation outcome?

## 2. The project

Since the authors have been working extensively with proprietary LMS (Blackboard) as well as Opensource (Moodle, Sakai, ILIAS, Google Classroom) and know their downsides they decided to use a social networking platform: Connections which is included in the IBM's Academic Initiative.

As a group assignment (25% of final grade) EMBA students had to design authentic digital stories. Each group consisted of 6 people and had to produce 6 stories and interpret 3. Since the average age was 35.9 years and the average work experience 10.8 years it was no problem for the participants to come up with a real life story. A total of 202 cross-cultural negotiations were analysed in our research.

For animations the use of Xtranormal(.com) and GoAnimate(.com) were recommended. Xtranormal is no longer marketed but there are more than 50 freely available authoring tools on the web. Most of them provide libraries with characters, languages, backgrounds, and special sound effects. Despite technical 3D capabilities the tools are simple enough to create a digital story in a matter of minutes. However, students had permission to use simpler formats such as Powerpoint presentations or Prezis if they could not master the recommended tools. Figure 3 shows an example of an animation from different perspectives. The underlying real negotiation story is about a German expat who has recently arrived in India together with his family and wants to buy a washing machine.

**Figure 3:** Screenshots authentic storytelling

Although both parties cannot be described as immensely culturally intelligent (according to the character description survey) they arrive at a positive win-win outcome in the sense that the German buyer got his machine plus a discount and the Indian seller her sale. In a class setting or online forum this may lead to the more general discussion whether cultural intelligence is a predictor for positive outcomes of a negotiation. The advantage of using real stories is that one can dig deeper. In the case of the German-Indian negotiation the audience questioned the buyer why he did not shop around for the highest discount in town and his answer was: "my wife told me that I must come home with a new washing machine tonight." This makes such stories different from artificial zero sum games in which students negotiate within a theoretical setting of given parameters. In authentic stories the personal context can be included in the analysis to augment the learning experience.

The perceived negotiation outcome was measured by a Likert scale from 1 (completely unsuccessful) to 7 (complete win-win situation). Figure 4 illustrates that most negotiations either failed or had limited success and others were successful with only a few in between. Based on 202 real life negotiations the pattern suggests an approximation of the actual outcomes of intercultural negotiations.

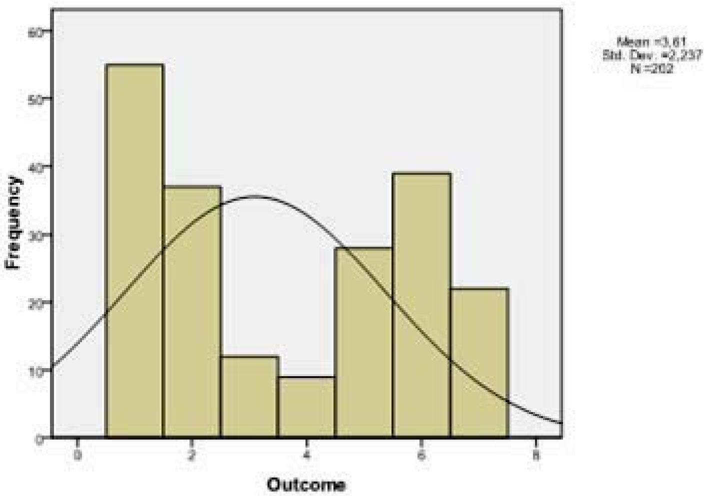


**Figure 4:** Negotiation outcomes

In a second step the groups had to relate the intercultural negotiation process to theory. Salacuse (2004) developed a comprehensive framework of how culture influences the negotiation process. Cultural distance seems to have more impact on the outcome than cultural intelligence (Bechter and Swierczek, 2015). A typical negotiation begins with a goal continues with attitudes and ends with risk-taking. For each factor, there is a range of responses related to one choice or another.

After the analysis of the negotiation process according to Salacuse's (2004) framework, the participants had to analyse the individual characters involved as third part of the assignment. For this characterisation they received a checklist containing 18 items (Likert scale 1-7) related to cultural dimensions/distances (Hofstede, 1991; Trompenaars, 2004; House et al., 2004) and a cultural intelligence test containing 20 indicators (Ang et al., 2007), see Appendix. Given this framework of measurements, participants had to select the answer that best described the characters in their digital negotiation. Since all stories had to be based on true events it was almost certain that one of the characters was the Executive MBA participant him/herself.

For the analysis we used multiple regression with outcome of the negotiation as dependent variable. The learning objective focused on the reflection of the results to confirm or contradict the participants own experiences.

**Table 2:** CQ and CD as predictors

| Regression Model | Predictor | Standardised Coefficients (Beta) | $R^2$: 0.730 Adjusted $R^2$: 0.69 |
|---|---|---|---|
| | CD Humane Orient | .424 | |
| | CD Time Orient | -.335 | |
| | CD Performance | .598 | |
| | CQ Adjustment | .183 | |

Table 2 shows the combination of Cultural Distance (CD) and Cultural Intelligence (CQ) as predictors. Time orientation was developed by Hofstede and Bond (1988). The negative beta stresses the importance of short-term orientation. Cultures with a short-term orientation generally exhibit great respect for tradition, a relative emphasis on the future, and a focus on achieving quick results. The long-term orientation relates to future actions. During a negotiation information is manipulated or withheld to obtain a quick result, this relates to short-term orientation. Performance and humane orientation are factors with the highest impact followed by adjusting behaviour during the negotiation. The combination of significant CD and CQ predictors, as listed in table 2, had an R square of 0.730.

At the end of the course students were asked whether the digital story exercise increased their cultural competence. On a 1-7 scale the average was 6.7 with a lowest score of 3. This shows that executive students benefit from such collaborative exercise and become more competent.

Below a few examples taken from the Discussion Forum which indicate how student felt doing the project. These show that in addition to the obvious fun of doing such authentic stories they could demonstrate their cross-cultural understanding and application of theories.

> *Female (Vietnamese): I've become more keen on the way…*
>
> *Male (Austrian): Samsung just took over the company I work for thus I can experience "live" the different cultural behavior. I have already put into practice the specific Korean negotiation & behaviors.*
>
> *Male (German): The project reminded me that things are indeed much more complex than "just having gained mutual understanding, adjust a bit and there you go" :-). It triggered me to approach one of my Indian colleagues about a deeper discussion of the culture training aspect.*
>
> *Male (Dutch): I suppose we are all aware of cultural differences but this assignment provides some practical tools to review these in a structured manner by using various theories. In short, it transforms the 'gut-feel' approach to intercultural management into a more academic and balanced methodology.*
>
> *Male (Indian): It will enable me to apply cross-cultural dimensions when I will be involved in intercultural situations professionally and also personally.*

*Female (Korean): As much as I have learned more about other cultures (more externally focused), the project also allows me to reflect on the understanding of my own cultural background and how it has influenced my behaviours for the last XX years. 'Thinking about the thinking process' 'Learning about the learning process'*

*Female (Japanese): This project gave me opportunities to reflect my intercultural experience vis-a-vis theoretical approach. It enriched my understanding of practical dimension based on people's real experiences.*

## 3. Implications

Authentic storytelling is an engaging learning experience. Instead of quasi experimental negotiation designs (e.g. zero sum game) an authentic project can mirror real-life situations. Relating the negotiation process to cross-cultural and negotiation theory provides a holistic view. Digital stories can be posted on the web (e.g. YouTube) or kept confidentially. Although Powerpoint collages can reflect feelings and emotions of a negotiation, it lacks the features of animations such as tone, sound, and body language. The more user-friendly animation software becomes the higher the number of learning applications will be. One could even think of authentic storytelling in the context of virtual reality where the story will become even more realistic.

For interpretation of the stories, students should be provided with theoretical frameworks in form of checklists to characterise the overall negotiation and also the actors involved. These checklists can be turned into questionnaires and subsequently the data analysed by statistical software. For the analysis of the actual negotiation it will need a content analysis software such as opensource Lucene and Solr. For example, it could be counted how often the word 'trust' or 'price' appeared in a negotiation. However, content analysis can be difficult. The challenge can be demonstrated on following sentence: Page sold his Gibson. Does Page stand for Google founder Larry Page and Gibson for Mel Gibson? Obviously not. The meaning is that Led Zeppelin guitarist Jimmy Page sold his Les Paul guitar made by a company called Gibson. Similarly, the term 'time' can have different meanings depending on the negotiation context. Even more difficult is the content analysis of animations. The algorithm would have to interpret gestures and other visual impressions. In other words, the software would have to pass the Turing (1948) test. For the time being even the best content analysis software will need a classification system of terms set by a human because automated interpretation of texts and animations is still beyond reach.

The results confirmed that an effective professional must be aware of cultural distance and context of the negotiation. S/he must not let the partner lose face and respect traditions which relates to the short-term orientation. At the same time, the negotiator has to value competitiveness and results and communicate in a direct and explicit way consistent with the performance orientation.

## 4. Sequence and timeframe for authentic storytelling blended learning project

- Face-to-Face with students (1-2 days)
- *Form teams of n participants.*
- *Show samples of former student batches' stories.*
- *Introduce digital story authoring tools (e.g. GoAnimate).*
- *Hands-on session.*
- *Introduce major cross-cultural theories which will later be taught online.*
- Online student-student (10 h / Student over a given period)
- *Students design n stories per team in a collaborative manner.*
- *Characterise the negotiation partners (real ones) by filling in a profile (based on relevant theory, e.g. Cultural Intelligence survey, Cultural Dimensions survey, student's own criteria; all: Likert scale, see also Appendix).*
- Online student-tutor (Webinar)
- *Present a prediction model for the outcome with an acceptable goodness-of-fit statistic.*
- *Reflect why or why not the outcomes confirm or contradict participant's perceptions and experiences.*

- *Present which models/theories (see Table 1) were applied (frequency count) in the analysis of the stories and ask for possible reasons.*
- Present Findings at the next ECEL Conference

## Appendix: Character description form

Select the answer that BEST describes the character in your Digital Negotiation Story. Name or nationality of character you analyse: ______________________________

| **Cultural Dimensions** | **Low** | | | | **High** | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Power Distance | | | | | | | |
| Individualism | | | | | | | |
| Uncertainty Avoidance | | | | | | | |
| Achievement / Affiliation | | | | | | | |
| Short / Long Term orientation | | | | | | | |
| Autonomy (intellectual - affective) | | | | | | | |
| Traditional (Embeddedness) | | | | | | | |
| Egalitarian / Hierarchy | | | | | | | |
| Harmony / Mastery | | | | | | | |
| Assertiveness | | | | | | | |
| Institutional Collective | | | | | | | |
| In-Group Collective | | | | | | | |
| Performance Orientation | | | | | | | |
| Humane Orientation | | | | | | | |
| Inner - Outer Directed | | | | | | | |
| Analysis - Integration | | | | | | | |
| Achieved - Ascribed | | | | | | | |
| Universal - Particular | | | | | | | |

Select the answer that BEST describes the character in the Digital Story (1 = not at all; 7 = very much)

| **CQ (Linn Van Dyne)** | **Not At All** | | | | **Very** | | |
|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Conscious of the cultural knowledge when interacting with people with different cultural backgrounds. | | | | | | | |
| Adjusts cultural knowledge when interacting with people from a culture. | | | | | | | |
| Conscious of the cultural knowledge applied to cross-cultural interactions. | | | | | | | |
| Checks the accuracy of cultural knowledge when interacting with people from different cultures. | | | | | | | |
| Knows the legal and economic systems of other cultures. | | | | | | | |
| Knows the rules (e.g., vocabulary, grammar) of other languages. | | | | | | | |
| Knows the cultural values and religious beliefs of other cultures. | | | | | | | |
| Knows the marriage systems of other cultures. | | | | | | | |
| Knows the arts and crafts of other cultures. | | | | | | | |
| Knows the rules for expressing non-verbal behaviors in other cultures. | | | | | | | |
| Enjoys interacting with people from different cultures. | | | | | | | |
| Confident to socialize with locals in a culture that is unfamiliar. | | | | | | | |
| Can deal with the stresses of adjusting to a culture that is new. | | | | | | | |
| Enjoys living in cultures that are unfamiliar. | | | | | | | |
| Can get accustomed to the shopping conditions in a different culture. | | | | | | | |
| Changes verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it. | | | | | | | |
| Uses pause and silence differently to suit different cross-cultural situations. | | | | | | | |
| Varies the rate of speaking when a cross-cultural situation requires it. | | | | | | | |
| Changes non-verbal behavior when a cross-cultural situation requires it. | | | | | | | |
| Alters facial expressions when a cross-cultural interaction requires it. | | | | | | | |

| Adaptive Behaviours | Not At All | | | | Very Much | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Knows other country’s eating culture. | | | | | | | |
| Knows the challenges of a parallel society. | | | | | | | |
| Can tolerate temperamental behaviour | | | | | | | |
| Enjoys tasting unfamiliar food. | | | | | | | |
| Can pronounce the given (first) names of locals correctly. | | | | | | | |
| Willing to accept waste of time e.g. waiting for someone | | | | | | | |
| Knows Hofstede’s cultural dimensions. | | | | | | | |
| Is aware of the coffee or tea culture. | | | | | | | |
| Knows local etiquette. | | | | | | | |
| Engages in popular sports discussions with locals. | | | | | | | |
| Has always an open ear for spouse’s cultural problems. | | | | | | | |

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# Engage the Students With Learning: A new Approach for an old Challenge

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**Abstract:** The transition to Higher Education can be challenging for some students, not just the practicalities of becoming the 'responsible adult' coping with day to day living coupled with the excitement of new found freedom, but educationally too. Many know "Uni will be different", realise the expectation of being an 'independent learner' but observations have indicated that sometimes this is where their knowledge and or motivation ends. Feedback from our 2013/14 NSS identified a growing level of concern from the students themselves regarding the commitment and engagement from some of their peers. The focus of this paper is to determine whether it is possible to manage expectations of being an undergraduate student, by demonstrating the level of commitment that will be required, before applying and or enrolling with any HEI. Our challenge was to design a fully online learning environment offering a positive and effective experience that could influence the epistemological beliefs of prospective students. The outcome could be that their beliefs are reinforced, maybe changed and possibly in some cases a realisation that they are not ready or willing to change. Sponsorship by Widening Participation at our Institution enabled a small team with diverse skills and experience to find a collaborative approach to this project. Acknowledging that MOOCs are a game-changer for HE offering large-scale availability, free access and useful analytics, we used their concept to design a holistic Business course. Participants were able to access course notes, watch lectures online and discuss issues with fellow learners. They were permitted to start where ever they wished and then progress through the topics before culminating in a decision by the learner either to leave the course or collaborate with others on a joint submission. The design gave the learners a unique insight to the subject and our Institution's approach to learning.

**Keywords:** collaboration, student-engagement, online learning environment, curriculum design

## 1. Introduction

Many colleagues across the Higher Education (HE) Sector have observed and written about the issue of student engagement and ways to improve it. External Examiner (EE) reports (2013/14) addressed to my own Institution commented on a growing perception of students not engaging sufficiently with their studies and feedback from the National Student Survey (NSS) 2013 and 2014 indicated that students themselves were raising concerns over the commitment and engagement from some of their peers.

As a Course Leader I have a responsibility to prepare an Academic Health report that responds to EEs and NSS and offer proposals for bringing about change. Inspired by a paper presented by colleagues from Northampton University who had designed a MOOC for release prior to enrolment but validated as part of a post graduate course, I approached my own colleagues with a similar idea but with our undergraduate applicants in mind and a rationale for influencing student engagement.

My proposal was to design a learning environment that would offer a positive and effective experience in order to influence the epistemological beliefs of prospective students before we have had a chance to meet them. The outcome therefore may be that their beliefs are reinforced, or maybe changed and possibly in some cases a realisation that they are not ready or willing to change.

The aim of the development therefore was to provide opportunities for prospective students to experience a dynamic and applied approach to business studies and to demonstrate the level of commitment they will be required to undertake before they apply and enrol for 3 or more years. Likely objectives would be to:

- Demonstrate expectations of student engagement through completion of individual and group activities;
- Gauge the students' transition prior to their arrival at University;

- Improve student retention by demonstrating the expectations of HE and providing opportunities for making a few friends before they join.

Initial investigations found that this proposal was the first within this Institution, but that there was already a policy stating that no MOOC development would be considered without the consent from the Centre for Learning & Teaching (CLT). I also discovered that our Learning Technology Advisers (LTAs) had purchased a MOOC platform but had not received permission to explore its benefits.

Having approached my immediate colleagues and found that all received my proposal with excitement and a willingness to contribute, two colleagues offered some wise words of caution, namely that a MOOC would take a lot of careful planning, collaboration and development time, so before agreeing to anything, what would I be able to offer in terms of time and space for that development. It was a good reflective point and led to the formation of a prototype, the subject of this paper.

## 2. Methodology

The project was in two phases, the first to design and trial a prototype in order to understand the longer-term implications for the organisation. The prototype was designed as a controlled environment, offered only to a small cohort of students who had agreed in advance to trial the activities.

Classified by Ullman (2003) as a “proof-of-production” prototype, this provided some empirical evidence to support the proposal for a future phase. The benefits of this approach include the “means to communicate the idea to others” (Yang & Epstein, 2005) in this case, offering reassurance to colleagues that full consideration is given to ensuring that standards are upheld in respect of branding and marketing at the design stage of the project. Students were requested to complete a qualitative evaluation before any response from us was received regarding their submission, asking what they liked/disliked, whether they had any expectations beforehand, what they were and if/how they have been met and how each of the learning outcomes has been met for them as an individual.

For the project team it provided a learning process and an opportunity for creating knowledge. Gerber and Carroll (2011) explain how people construct new knowledge through observations which lead to insights that can support frameworks and inspire ideas that lead to innovative solutions. In this context it is about understanding the practical implications from the outset of the design, its implementation and the monitoring of activities to be delivered beyond the normal boundaries of the University.

Specifically, it was intended to offer a comfortable environment for colleagues to experiment and to remove the feelings of uncertainty in order to encourage ideas, discuss new pedagogical concepts, trial new technologies and collaborate with colleagues from other departments. It was a good opportunity to remind ourselves how the students would be feeling at the start of any new experience. All colleagues were invited to an evaluation meeting to discuss their own learning points and comments for further development.

Further understanding gained from the literature included student engagement, pedagogical strategies and possible influence on preferred learning styles and curriculum design implications.

The second phase was still developed as a controlled learning environment rather than an ‘open online course’ and only offered to anybody from any institution working with our sponsors, the Compact Operations Outreach Group (COOG). This is where the concept of a MOOC helped with the design, we did not expect to know who had applied, or how many and therefore all activities would need to reflect this. The students were again requested to complete an online evaluation to help with this development. One question was asked before they started and 5 more were asked at the completion of the course. The analytical tools embedded within the software allowed the team to gather quantitative data to identify how the activities have been used by the students, the frequency and completion rates.

## 3. Design framework

The project team was representative of subject academics from the Business School, a Learning Technology Adviser and an academic from the Centre for Learning and Teaching. All brought varying degrees of knowledge and experience of developing online materials and all monitored their own skills development with a view to embedding improvements into their own teaching practices.

"A design task begins with a requirements analysis", advises Laurillard (2012). Understanding who the target audience is, what their goals may be and balancing these with the requirements of other stakeholders is the norm for any new concept and provides another good reason for developing a prototype, much smaller and more controlled than the original proposal of something far larger and with more unknowns.

As experienced University lecturers, the team were used to the challenge of providing learning strategies for ever-growing and diverse cohorts without knowing the cultural backgrounds or previous learning experiences the students will bring with them. On this occasion, an additional factor was that we would be preparing materials for students younger than we were used to working with.

The analysis for the first prototype therefore, began with who our sponsor was, their remit and the students who they would be engaging with not forgetting the rationale behind the proposal, namely student engagement.

The Widening Participation policy in our University is committed to widening access to higher education for under-represented groups and those with little or no family history of higher education. The COOG team agreed to sponsor us for this development and in turn were asked to find some partner schools/colleges who would be offering HE 'taster experiences' for their students and who would be willing to work with us to trial and evaluate our prototype. Three colleges volunteered and each nominated four students to work with us. All that we required before beginning the taster was the (College) email addresses for each student and the contact details for a technician from each college. College tutors would also be invited to participate as 'student users' rather than 'instructors'.

The next consideration was for the subject itself: Business. As a 'taster' for Business it needed to emulate the level 4, (first year) business degree currently offered by us and being a 'contained' course it needed also to offer a holistic overview of business or 'big picture' perspective. The subjects chosen for representation were Economics, Marketing, Finance and HR and the tutors prepared materials and work areas specifically for these.

The Virtual Learning Environment (VLE) was a free open learning platform CourseSites™ produced by Blackboard™. Our internal VLE is also Blackboard™ so we were all familiar with how to use it and the tools within. We developed our own IT skills by preparing the online materials via 2 new applications (for us) Camtasia Studio™ and Nearpod™. Together these permitted us to produce interactive sessions, audio and video uploads and analytics which could be shared with the students. The materials developed via Nearpod™ were accessible "via all devices" which was a big influence on our decision to use it.

## 4. The Mooc concept

MOOCs have been highlighted as "transformational disruption" (Billsberry, 2013) with high-ranking universities being cited as leaders in their development, leaving others to wonder whether this is just another fad or something to be taken more seriously.

In the UK the Open University (OU) is the outstanding leader as a provider of online courses, and with the barrier to entry set to an exemplary high level, it is no wonder other HEIs have not been tempted to compete.

The aim of the prototype is not to sell or market our courses but to highlight and communicate our expectations for all undergraduate students, which is that they will assume greater responsibility for their own learning. We will have no prior knowledge of them, who they are, what experiences they will bring with them, nor an opportunity to find out about them, but we will want them to develop "characteristics of autonomous, proactive and constructive engagement" (McCabe and O'Connor, 2014). In order to achieve this, our design will need to ensure a level of contribution that encourages motivation and active participation. As with our 'regular' teaching, a variety of pedagogies will be appropriate and will include timely individual input to group working, peer teaching and feedback and initially at least an element of blended learning which in this context I mean it to be interaction with a tutor via some form of technology.

MOOCs, seem to be ignoring the traditional educational principles of teacher-student interaction and feedback, (Baggaley, 2013) instead placing the responsibility for learning firmly back with the students, so by way of reconciling two potentially diverse strategies, it seemed appropriate to look for a constructivist approach for this prototype.

Hussain (2012) describes constructivism as the theory which places emphasis on providing opportunities for students to make their own judgements and interpretations based on their prior knowledge and teachers should actively involve students to participate in the teaching and learning process. From a slightly different angle, Tangney (2014) discusses 'student-centred learning' from a humanist perspective with the underlying emphasis being on self-belief. This supports Kahu's (2011) research particularly as Tangney continues with an acknowledgement that people (students) can develop this way if they feel that their environment is genuine and empathetic.

Gale and Parker (2014) emphasize four points that complement Hussain, Kahu and Tangney namely the importance of

- "Creating collaborative and inclusive spaces where students can be encouraged to share their beliefs, knowledge and experiences;
- Develop student-centred strategies including activities that can enable students to ground their learning in something relevant to them
- Connect with students' lives through topics that are relevant to their immediate lives or their imagined roles or professional lives
- Being culturally aware by including stories or relevant examples to aid learning"

The challenge therefore is to create a non-threatening environment, allowing students to explore a new experience and to learn about accepting the risk of getting it wrong and to share emotions of anxiety, shyness and success.

Gale and Parker (2014) refer to the first year experience for any HE student as being "the most critical time" likely to inform their success or failure, and like any other HEI we offer an induction programme to help settle new students into our organisation with activities to prepare them for the programme of study to come. The proposal for the development of an online taster, as with Fitzgerald et al (2014) is to consider whether this transition period can begin prior to joining the University.

MOOCs are generally considered to be free online courses that anyone can sign up for. Billsberry (2013) suggests that their arrival is due to improvements in the Internet and more people having access to learning and so are the latest instalment in the development of distance learning. Baggaley (2013) states that there is very little about the MOOC which is actually new and refers to the research of Bagley (1911) for recommending guidelines for efficient instruction and Chu and Schramm (1967) on how to design educational television. Both works were later reviewed to produce the 'universal instructional design' (Scott *et al*, 2003) citing the need for straightforward and consistent instruction, and above all the importance of teacher-student interaction. Baggaley also notes that it is only the 1911 work that mentions the need to communicate high expectations to students.

MOOCs currently, seem to vary in content and professional standards according to the investment made by the presiding university, many are not credit bearing and completion rates do not seem to be overly high, but Billsberry (2013) suggests that if the investment is made and production is to a high standard, it is possible that the university will be able to re-use them as often as they wish, continuing that MOOCs may create a 'try-before-you-buy' environment.

## 5. Student engagement and transition

Kahu (2011) suggests that student engagement is a complex and multi-faceted matter and proposes a framework that encompasses the perceptions, expectations and experience of being a student. While not generalising or stereotyping, Kahu advises that an enthusiasm for the topic and a sense of belonging to a learning community will positively influence student engagement continuing that staff-student relationships are at the core, also acknowledging Nystrand and Gamoran (1991) in their belief 'that engagement depends on what teachers and students do together… neither can do it alone'.

Kahu also promotes the idea that "engagement breeds engagement", advocating that within an iterative process of belief and trust in the available resources to help themselves, students will become more effective in helping themselves, in turn increasing their confidence and engagement, so promoting improved relationships and engagement, leading to better grades and greater motivation to become engaged.

Gale & Parker (2014) may argue that this is a transitional process, defining transition as “the capability to navigate change” and referring specifically to “resourcing” students’ capabilities for this purpose and Hussain (2012) advises that a University education should aim at developing skills and competencies among students to live and work in the 21st Century, enabling them to interpret their knowledge according to situation(s) by making their own meaning of it.

These authors put the responsibility of motivation and engagement with learning back with the students but currently the design of all courses and support materials still lie with the tutors, therefore it is important to understand how our designs can support the students in their transition ‘from one institutional context to another’ and from ‘one student identity to another’ (Gale & Parker, 2014).

Observations of and conversations with my own students increasingly highlights differences among them specifically that for some, while recognising that HE “will be different” and they will need to do more work on their own, many do not understand what this entails, what the benefits are to them or how to find the time to do it. Course representatives are stating that many peers just wish to know ‘how to get a good mark’ and the NSS is indicating that the student body is becoming increasingly frustrated with this.

Without further investigation to discover how representative these views are I have taken this as a request for help while sympathetic with the view that students can do a lot to encourage and learn from each other.

## 6. Practical Implications

We chose to describe the prototype as an ‘Online Taster’. By removing the term ‘MOOC’ it meant that we were able to develop something more contained, were able to restrict access and although it is still leaving the University’s boundaries, we were able to monitor it more closely not just from an academic perspective but from a technology support perspective too. The activities, the students’ engagement, and feedback were measured against the Learning Outcomes for the Taster previously identified. This supporting evidence will underpin the proposal for the next phase, which must be approved by our senior managers.

The learning outcomes were identified as:

- To work independently
- To work as a team with people they have not met
- To work as a group within their own college
- To use technology as part of their learning
- To prepare for time spent with tutors
- To manage their time to meet a specific deadline

The design introduced a brief whereby each College group should produce one solution to the same problem. The solution should draw on 4 subject areas associated with general business and required one student member from each college to represent one subject area and to work collaboratively within the subject teams and a subject tutor, to enhance their knowledge. A team space and online discussion board was created in the VLE to allow for this collaboration to “build knowledge” (Laurillard, 2012). They were given opportunities to independently work through online activities, engage in discussions with peers within their subject teams and at given times, spent time with the subject tutors online to discuss issues and ask questions. The message for the last point was that the time is precious and must be prepared for and used well. Finally, they each took back a summary of what they have learned to their College group. The Group needed to discuss and agree a response to the same problem but taking into account each other’s views and learning points.

Figure 1 illustrates the framework that underpinned the first phase of the project.

By maintaining the ‘silos’ the students could be allowed to choose a subject that they are comfortable with or be encouraged via their own tutors to try another in order to generate some skills or knowledge development. It also ensured that each student would have to work with others that they have not previously met, would overcome any shyness by drawing on previous team building experiences which hopefully would then motivate each student to be prepared in advance of any team meetings to avoid the embarrassment of having nothing to contribute, and instead demonstrate the reward and pleasure of being engaged.

<table>
<tr><td></td><td>College 1<br>(a group of 4)</td><td>College 2</td><td>College 3</td></tr>
<tr><td>Finance</td><td colspan="3">1 student from each College will represent each of the subject areas and will work collaboratively as a subject team:</td></tr>
<tr><td>Marketing</td><td colspan="3">Subject area output:<br>Each individual student will determine for themselves what they are taking from this team back to the College Group as input to the Group discussions</td></tr>
<tr><td>HR</td><td colspan="3"></td></tr>
<tr><td>Economics</td><td colspan="3"></td></tr>
<tr><td></td><td>The 4 students from each College will work as a group on a joint assignment drawing from the subject areas and will have one group (College) Submission</td><td></td><td></td></tr>
</table>

**Figure 1:** Prototype framework

The College Group would produce one submission to be uploaded by a given date/time and would receive feedback from their tutors also online. The choice of submission format was left to the students for example an audio-recorded presentation, video, written report whatever they considered to be the most appropriate format. The opportunity for the student collaborative learning at this point will demand more than discussion, argument, question and answer but a group consensus on producing the output, (Laurillard, 2009). Our LTA was confident that "we will cope" and that this is part of the learning outcomes for us. The timescale for this taster was a period of one week. This should allow the students some time for independent study before meeting as a subject team and returning to their groups to produce the joint submission.

## 7. Conclusion

Our initial idea was too complex for an online environment for these participants. It was too reliant on others making it work (college teams, tutors and technicians) and we had no control over or ability to offer technical support outside our own boundaries. Of the promised 12 students only half actually took part, and while they were from the different partner institutions, there were not have enough from each school to represent all subject groups. We also found it difficult to co-ordinate the subject tutorial sessions which meant that the students were left to attempt access by themselves and then stayed together in one subject area rather than individually 'attending' another subject tutorial.

For our part and with reflection, the first iteration highlights what we as a team are actually doing 'for real' through our own roles and duties and it served to show us how approaching something new requires some courage. It demonstrated the need for an environment which balances the challenge of a new project aiming to promote creativity with reducing and eliminating the fear of failure by acknowledging the 'normality' of not getting it right first time but ensuring that it becomes a learning opportunity for everybody. So on a more positive note, as a team and as individuals we gained new skills and understanding. As project lead I observed how my colleagues had collaborated and shared experiences, I noticed their enthusiasm for their subjects as they discussed the task from each perspective while persuading each other of their respective view point. It was exactly this that I was hoping to encourage and bring about with the students during the course.

In real terms the results of the first taster were disappointing however, as is the point of a prototype what we did learn was that we had gained new knowledge and had highlighted our project well enough to receive continued sponsorship from COOG and all were motivated to continue with the development of the next stage of the project.

## 8. The learning points

The students who replied to our evaluation told us that they had enjoyed taking part, had tried their best but had struggled with the technology and some had not really understood what they had to do. This meant that we needed to revise our expectations in relation to these students and the availability of tutors from all institutions. Although we noticed that the students did work together it was not as we had intended and we felt that the group work element and scheduled tutorials were too complex at this stage.

Specific changes included thinking about a sustainable design that could be repeated as often as our sponsors required but without committing us as tutors to be available on every occasion. Something our own timetables and diaries may not permit and we had realised when trying to schedule co-ordinated online tutorials. It also had to be accessible to students without the complication of technical support and the instructions needed to be embedded within the taster.

We retained what we considered to be the good points, the overall assignment for the students with a focus on one question but from the perspective of 4 different subjects. The activities would still develop the individual's skills, provide opportunities to participate in a new environment and complied with Gale & Parker's point of connecting with students through topics relevant to them.

## 9. The next phase and amended online taster course

We have progressed to the second phase and this continues to be sponsored by and developed for the COOG team. We now know from the first experience that not every student at school or college wishes to participate in taster events, but the mobile learning approach can still provide individuals with learning opportunities that demonstrate how business solutions are reached from different subject perspectives. We may yet encourage individuals to try and take a smaller but nonetheless important step in the next stage of their academic careers.

We removed the group work element and changed the online platform to one that did not require individual log ins and the need to involve technicians and tutors from the schools and colleges, which had proved difficult in the earlier phase. All that was required was a URL and a password. We still wished to control the access to the Taster to ensure that we could easily monitor how it was working, make changes as necessary, and offer something a little more unique to the COOG team. The Taster Course was accessible via any mobile device or workstation and any platform which reduced the problems experienced earlier. The COOG team would be the ones to explain to schools and colleges how the taster would work and what to expect from it.

The aim of the second phase continues to be to provide opportunities for prospective students to experience a dynamic and applied approach to business studies and to demonstrate the level of commitment they will be required to undertake before applying or enrolling to any HEI, but this phase may now be reviewed as the first step in a longer journey where we still hope to

- Demonstrate expectations of student engagement through completion of individual and group activities;
- Gauge the students' transition prior to their arrival at University;
- Improve student retention by demonstrating the expectations of HE and providing opportunities for making a few friends before they join.

The learning outcomes for this phase of the online taster course have been revised to

- Work independently
- Use technology as part of their learning
- Understand that a business solution may look different depending from which perspective it is viewed.

We also lifted the restriction on the number of students who could take part meaning that as few as 1 from each school or college could participate but that many more schools and colleges could take part if they wished. Our expectations now are that this phase of the Online Taster will be more manageable but still takes us towards our original aim and eventually we will find a way of reintroducing the very important group element to our taster course.

The outcomes of this next phase are the subject of a separate paper.

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# Anthropomorphic Faces and Funny Graphics in an Instructional Animation May Improve Superficial Rather Than Deep Learning: A Quasi-Experimental Study

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**Abstract:** Information about what visual elements in instructional animations enhance learning via mediating effects of elevated engagement is largely lacking. In this study, high school students (*n* = 41) interacted in a laboratory with a roughly 6-minute-long, black-and-white, instructional animation with "emotionally" enhanced graphics. The topic was biological wastewater treatment. The enhancements included a) adding static faces for two schematic visual elements and b) changing the neutral appearance of a fish and a river bed to funny appearances. The participants' learning outcomes (assessed by retention and transfer tests) and the participants' state engagement (indexed by generalized positive affect and flow levels) were compared to data from a group of comparable students interacting with the same animation with neutral graphics (*n* = 37) in a previous study. The two groups did not differ in state engagement (flow: *d* = -0.16; positive affect: *d* = 0.03) and transfer test scores (*d* = 0.13), but there was a small trend favoring the enhanced graphics in the retention test, when corrected for pretest scores ($\eta^2$ = 0.038; *p* = .095). Qualitative data suggest that the graphical enhancements might serve as memory cues during the test phase for some participants. The small effect of the enhanced graphics on retention may thus be of cognitive, rather than of affective, origin. This study demonstrates the importance of considering emotional manipulations in future research.

**Keywords:** multimedia learning, animations, emotional design, flow, positive affect, e-learning

## 1. Introduction

Instructional animations are an important member of the family of educational tools and a notable example of e-learning technology. They can be used in various ways; for instance, by students who self-study at home or by teachers showing them to the class on a projector. From a theoretical perspective, animations are computerized multimedia learning materials: they combine text and pictures (Mayer, 2009) and use computers as a presentation medium.

Principles exist for how to design multimedia learning materials, including animations, so that their instructional message can be cognitively processed by learners in an effective way (Mayer, 2009; Clark & Mayer, 2011). These principles are not only empirically-based, they are also theoretically well organized by the frameworks of the Cognitive Theory of Multimedia Learning (Mayer, 2009) and Cognitive Load Theory (Sweller, Ayres, & Kalyuga, 2011). No complementary principles are available for how to design multimedia learning materials so that they are not only cognitively optimal, but also affectively appealing; further enhancing learning (i.e., emotional design principles; Plass & Kaplan, 2016). Absence of such principles is a notable drawback because students' affective states are quite important in educational contexts and they influence learning (e.g., Pekrun, 2006), decision making (e.g., Isen, 2001), and memory (e.g., Linnenbrink & Pintrich, 2004). In fact, only a handful of studies have addressed the issue of emotional design in the context of multimedia learning (see, e.g., Mayer, 2014; Park et al., 2015; Heidig et al., 2015). Even the field of educational computer games, which can be viewed as multimedia learning materials in a broader sense, has limited knowledge of what game features create an affectively optimal experience that enhances learning (see Wouters et al., 2013).

One possible emotional design principle is "to anthropomorphize graphical elements in the materials" (cf. Park et al., 2015; Mayer & Estrella, 2014). An example of this principle is adding human-like faces and/or expressive eyes to otherwise non-human entities. Recent research has demonstrated some benefits of this design principle both in affective and cognitive terms; especially when a gray-scale or a black-and-white visualization is enhanced by warm, bright colors (Um et al., 2012; Plass et al., 2014, Exp. 1; Mayer & Estrella, 2014; but see also Plass et al., 2014, Exp. 2). Another possible emotional design principle is "to change entities' graphical appearance from a neutral one to a funny one". This design principle is intuitively used by the designers of many entertainment games. However, whether or not it is beneficial for learning remains unclear (Snetsinger & Grabowski, 1993).

The present study investigates whether a subtle pictorial manipulation in a 6-minute-long, black-and-white animation increases learners' state engagement and thereby enhances learning. We emotionally enhanced the neutral visual appearance of an already existing instructional animation on the functioning of a wastewater treatment plant in the following ways: A) we added static human-like faces to two, otherwise schematically portrayed, chemical elements; B) we changed the neutral appearance of a mutated fish to a funny appearance; and C) we changed the neutral appearance of garbage at the river bed to a funny one. We used no colors and the added faces were static (i.e., without expressive eyes or mouth).

The study thus compares learning from two versions of the same animation: one version with a neutral visual appearance and the other with an emotionally enhanced visual appearance. Specifically, for this study, we recruited participants for the enhanced condition and compared their results to those of participants who interacted with the animation's neutral version in a different study (Brom et al., submitted). Would the enhanced graphics be beneficial for participants' engagement and learning results?

## 2. Theoretical background

Traditionally, the design principles of multimedia learning (e.g., Mayer, 2009; Clark & Mayer, 2011) focus on the cognitive aspects of processing learning messages rather than the materials' affective appeal (cf. Mayer, 2014; Um et al., 2012; Heidig et al., 2015). Likewise, the related theories, such as the Cognitive Theory of Multimedia Learning (Mayer, 2009), focus primarily on the cognitive dimension of learning. Yet over a dozen affective states that students experience during learning by means of new technologies have been robustly identified (reviewed in D'Mello, 2013). Only recently, affective dimensions have started to be considered by multimedia learning researchers.

*State engagement*, also called engaged concentration (e.g., Baker et al., 2010), is an important affective state. As far as we know, it has so far not been operationalized precisely, but it has been tentatively linked to mild generalized positive affect and certain components of flow state: such as focused and intense attention.[1] As such, it can be indexed by a Positive Affect Schedule (Watson, Clark, & Tellegen, 1988) and a flow inventory such as Flow Short Scale (Rheinberg, Vollmeyer, & Engeser, 2003). We use these two constructs in this study, i.e., generalized positive affect and flow levels, as proxies to state engagement.

As a theoretical basis for linking state engagement to learning effects, we use an "affective" expansion of the Cognitive Theory of Multimedia Learning: the Cognitive-Affective Theory of Learning with Media (CATLM) (Moreno, 2005). In a simplified way, the CATLM posits that the effectiveness of learning depends on the effectiveness of selecting relevant information by the learner from the instructional message, its organization into a coherent mental model in the learner's working memory and the integration of this model into the learner's prior knowledge base. The efficiency of these processes depends, to a certain extent, on the amount of cognitive resources allocated for them. The amount of cognitive resources, in turn, depends on some other variables; including the level of actual engagement in the learning process (i.e., the state engagement). The higher state engagement is, the more cognitive resources will be allocated for the activity being undertaken: up to a certain point.

However, there is the following trade-off: manipulation of multimedia learning material can increase state engagement and thereby the amount of allocated cognitive resources (enhancing learning). However, at the same time, it can also require a substantial amount of cognitive resources for the cognitive processing of this manipulation (hindering learning). A prime example of an engaging manipulation that hinders learning under many circumstances is seductive images (i.e., illustrative images adding engaging information that is only weakly relevant for the core learning message) (Mayer, 2009). Therefore, multimedia learning researchers have started looking at how to alter learning materials to induce and/or to keep high state engagement during learning, while minimally distracting the learner from the cognitive processing of the instructional message's core. This effort can be called an emotional design research program (cf. Plass & Kaplan, 2015).

[1] The relationship between positive affect and flow state, on the one hand, and state engagement (engaged concentration), on the other hand, was pointed out to us by Sidney D'Mello [email correspondence from 9 March 2014].

The emotional design research program is in its infancy. As concerns changing neutral visualizations to funny ones, we are aware, as of now, only of a study by Snetsinger and Grabowski (1993), which reported null results. As concerns adding anthropomorphisms in combination with warm and bright colors, Um et al. (2012) demonstrated its beneficial impact on deep conceptual learning (as measured by transfer tests) and comprehension; whereas, Plass et al. (2014; Exp. 1) and Mayer & Estrella (2014) showed impact only on comprehension[2]. Plass et al. (2014; Exp. 2) demonstrated the beneficial impact of anthropomorphisms on comprehension, but only grey-scale anthropomorphisms had positive effect on transfer. Park et al. (2015) showed improvements in comprehension (but not in transfer) when a treatment with warm-bright-color anthropomorphisms was compared to a warm-bright-color, non-anthropomorphism baseline. At the same time, participants underwent a mood induction procedure prior to the learning experience. Both Um et al. (2012) and Plass et al. (2014) found that anthropomorphisms had positive impact on positive emotions/engagement. However, this was not so for Mayer and Estrella (2014) and Park and colleagues (2015). Generally, the impact of anthropomorphisms tends to be neutral to positive and somewhat unstable; effect sizes are in very small to large ranges (and also differing based on the control conditions).

This study's contribution is that it tests the effects of new "emotional" manipulations: additions of static black-and-white faces and two black-and-white funny elements (rather than manipulating color and/or adding expressive faces). We used three changes all at the same time, because the animation is dynamic (its visual appearance changes) and we wanted at least one enhanced element to be present on the screen at any moment.

Because sparse prior research demonstrated some benefits of anthropomorphic enhancements, we put forward the following hypotheses:

> ***H1:*** *Learners' state engagement induced by the learning, i.e., measured immediately after the learning, will be higher with the enhanced graphics.*
>
> ***H2:*** *Learners' knowledge test scores will be higher with the enhanced graphics (for both retention and transfer).*
>
> ***H3:*** *The effect of the graphics on learning results will be mediated by state engagement.*

## 3. Method

### 3.1 Study design

The study uses a between-subject quasi-experimental design with two conditions. Participants assigned into one of the conditions learnt about the process of how a biological treatment plant functions from about 6 min long animation. One condition used a neutral graphics (the N version, Figure 1) and the other emotional graphics (the E version; Figure 2). The animations did not differ in the expository instructions.

For the purpose of the present study, we recruited participants for the E condition only. In the present study, we compare learning outcomes and state engagement of these participants to learning outcomes and state engagement of participants recruited for the purpose of our *previous* study (Brom et al., submitted) into the N condition. (The previous study used more conditions but we use one of them for comparison in the present study as the N condition, as detailed below.) Therefore, participants were not randomly assigned into the E and N conditions. We instead recruited first the participants for the previous study (May 2014 - March 2015) and when that study ended, we started recruiting for the E condition (April 2015 - May 2015).

The primary dependent variables are generalized positive affect and flow levels (as proxies for state engagement), and retention and transfer test scores. The studies use also several auxiliary dependent variables, which we denote as "affective" variables: on generalized negative affect, on self-assessed learning, on the animation's usefulness, on the learner's level of interest and motivation, on the learner's perception of difficulty in learning from the materials, and on the animation's friendliness.

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[2] Retention tests assess superficial learning: basically if the learners have memorized the content and are thus able to recall it. Transfer tests investigate deep understanding of the process/model learned by application of the knowledge in new situations (Mayer, 2009). Mayer and Estrella (2014) used classic retention and transfer tests. Um et al. (2012) and Plass et al. (2014) used transfer tests and comprehension tests. In our opinion, the latter were similar to retention tests.

### 3.2 Participants

Participants recruited for the E condition were 41 high school students (Mean age = 17.54; SD = 0.64) with intentionally diverse backgrounds. All students planned to pursue university studies (diverse study programs). There were 66% females. Students were recruited via an online server advertising short-term jobs for students. We invited them to participate in a 3 hour long experimental “workshop” for a compensation of 350 CZK (approximately 13 EUR). This workshop had two parts. The first part was the current experiment. The second part was unrelated to the present experiment (in the second part, we investigated how students learn from a certain educational game). The workshop was an extracurricular afternoon activity for the students.

Participants in the N version, who were originally recruited for the purpose of a different study (Brom et al., submitted), were recruited in the exactly same way as the E condition participants and participated under the same conditions. There were 37 participants in the N condition with the same background characteristics as the E condition participants (Mean age = 17.27; SD = 0.96; 54% females; diverse study background).

Eleven additional participants were excluded (N condition: 6; E condition: 5). The reasons for exclusion were: native language being neither Czech nor Slovak (Slovak is very close to the Czech language), being extremely tired at the beginning of the experiment, not answering questions on the knowledge tests.

### 3.3 Intervention

The intervention was a short, black-and-white animation explaining the process of biological wastewater treatment (see Brom et al., submitted for details). The animation consisted of 19 screens, each with a few lines of expository instructions placed at the bottom of the screen. The animation was controlled by learners using the “next” button. The average time to completion was around 6 minutes. The animation had 348 words.[3]

The visual appearance of the neutral version (Figure 1) was altered to produce the emotional version (Figure 2) in the following way:

- two chemical elements were anthropomorphized by adding schematic human-like faces (the “anthropomorphism” design principle);
- the fact that one of the chemicals is toxic for aquatic organisms and can cause mutations was highlighted by mutating the fish (the “fun” design principle);
- a neutral appearance of garbage at the river bed was changed to a funny appearance (the “fun” design principle).

### 3.4 Paper materials

The paper materials consisted of a pretest with a background questionnaire, an initial motivation questionnaire, a prior and a post hoc inventory on generalized positive and negative affect, a post hoc flow questionnaire, a retention test, a transfer test, and a feedback questionnaire. All of these are further detailed below and in more detail in (Brom et al., submitted).

The background questionnaire yielded information about a participant’s age, gender, study type, and native language. It also included one question on self-assessed knowledge of mathematics (a 6-point Likert scale), one question on frequency of playing videogames (a 4-point scale), one question on the frequency of playing live action experiential/simulation games (a 5-point scale), and two questions on prior tiredness (a 6-point Likert scale). These questions were included primarily to verify that the groups were balanced with respect to these variables.

The pretest was based on Moreno and Mayer’s self-assessing pretest (2000; Exp. 1, 2) and it was intended to measure participants’ knowledge of chemistry and biological wastewater treatment. It contained ten questions (total scale 0-25). The question example is: “Please, make a check mark next to this sentence if it is TRUE in your case: ‘I can thoroughly explain to a high school student how aerobic bacteria relate to wastewater treatment’”.

[3] The original study (Brom et al., submitted, Exp. 4) compared two animations with the same graphics (i.e., the present neutral version) but with different texts; so-called “personalized” and “formal” versions. The “personalized” version of the texts is used in the present experiment (for both the E and N conditions).

The initial motivation questionnaire was a shortened version of the QCM inventory (Questionnaire on Current Motivation; Rheinberg, Vollmeyer, & Burns, 2001) and it was administered to assess participants' initial motivation to learn the given topic. Items with a 7-point Likert scale were organized into two factors: interest (5 items; Cronbach's α = .66) and anxiety (3 items; α = .73).

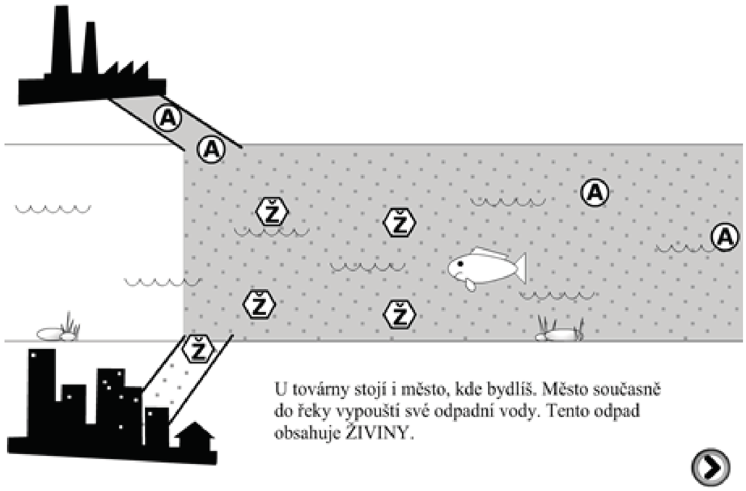


**Figure 1:** A screenshot of the neutral animation version

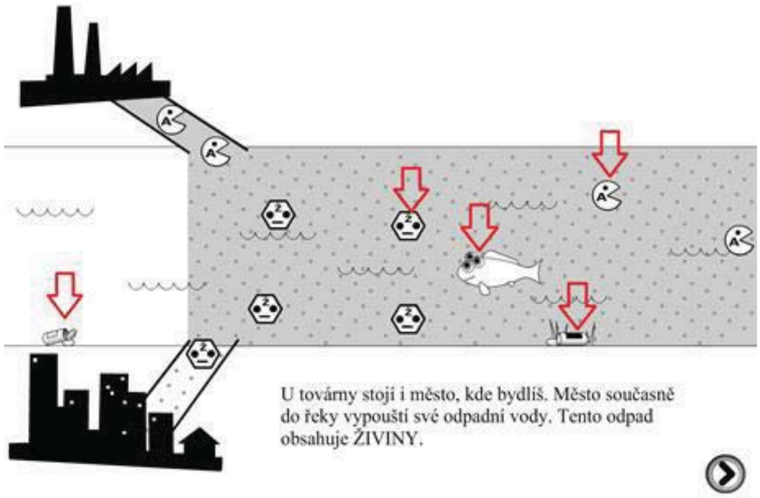


**Figure 2:** A screenshot of the emotional animation version. The arrows highlight the changes

To assess flow levels, the Flow Short Scale inventory (Rheinberg, Vollmeyer, & Engeser, 2003) measuring induced level of flow with 10 items with a 7-point Likert scale was used (α = .80). As concerns the generalized positive and negative affect, we used the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988). We measured affective state twice: immediately before and after the intervention. The schedule's positive dimension is denoted as PANAS+ and its negative dimension as PANAS-, the pre-intervention PANAS as PANAS1 and the post hoc PANAS as PANAS2. The tests' internal consistency was as follows: PANAS1+: α = .80; PANAS1-: α = .81; PANAS2+: α = .86; PANAS2-: α =.70.

Our retention test included the following open-ended question: "Based on the animation you just saw, describe in detail how biological wastewater treatment works". The transfer test included four open-ended questions. The question example is: "What would happen if a fungus first appeared in the treatment plant and then bacteria? Write down all consequences that come to mind based on the animation you saw today.". Participants could receive one point for each of 19 key idea-units in the retention test, or half a point for a partially correct idea-unit. These units reflected key steps in how a biological wastewater treatment plant functions as described in the animation. Likewise, participants received one point for every creative solution to a transfer test question, or half a point for a partially correct solution (open-ended scale). Solutions based only on prior knowledge were not rewarded.

The feedback questionnaire included the following questions with an 8-point Likert scale: two questions on self-assessed learning, one question on the animation's usefulness, two questions on the learner's level of interest, one question on the learner's level of motivation, one question on the learner's perception of difficulty in learning from the animation, and one question on the assessment of the animation's friendliness. The questionnaire also included eleven additional questions irrelevant for this study's purpose.

### 3.5 Interview

After interacting with the animation, participants in the E condition were briefly interviewed regarding the perception of general animation's usefulness, perception of graphics (Was or was it not funny?), and suitability of graphics for educational purposes (What do you think about the graphics? Did or did it not help in learning?). Participants were also asked what, if any, visuals they recalled during filling in of the tests and if that was helpful when answering the test questions.

### 3.6 Procedure

Participants were tested in groups of 1-9 per session, each seated at one computer with at least a 17" wide screen. After the introduction, participants filled in, at their own pace, pretests, background questionnaires, the questionnaire on initial motivation and the prior PANAS (note: participants had not yet seen animation graphics at that time). Afterwards, participants received the animation according to their condition; all participants started at once. Immediately after a participant finished, he/she received the Flow Short Scale followed by the post hoc PANAS and the feedback questionnaire. Afterwards, the retention test was administered, followed by the transfer test (the timing was strict for the two tests). Responses to each question were collected before the next question was distributed. Participants were then interviewed and thanked. Then, after a break, participants proceeded in the second part of the workshop (which is irrelevant for the present study).

## 4. Results and discussion

Both groups were balanced with respect to the following variables: self-assessed knowledge of mathematics, frequency of videogame play, frequency of Larp participation, frequency of live action experiential/simulation game play, both factors of initial motivation, tiredness, both prior PANAS+ and PANAS-, and the average time during which participants completed the animation. We found significant differences as concerns pretest scores ($t(76) = 2.55$, $p = .013$, $d = 0.58$, 95% CI [0.12, 1.04]). Because this variable correlated with retention test scores ($r = .23$), though not with transfer test scores ($r = .07$), we took it as a covariate (and report the results both with and without taking the pretest as covariate).

Regarding qualitative data, during the interviews, participants commented on the graphics in the E version as being "appropriate for an educational animation", "well arranged" and/or "generally not distractive". The mutated fish was described as "funny" or "great", though sometimes as "distracting the learner from the learning"; the chemicals were described as "clearly understandable" and learners viewed them positively; and comments regarding the river bed were scarce. Some participants reported that the recall of particular visual elements helped them during filling in of the tests. Considering these points together, qualitative data indicate that the participants noticed the altered graphical elements, especially the fish and the chemicals' faces (which is a manipulation check); that our "anthropomorphic" manipulation might influence state engagement of learners; and the "funny" manipulation was noticeable regarding the fish, but less so regarding the river bed. Generally, the altered elements were not distractive, possibly with the exception of the fish for some participants. The case of fish probably exemplifies a trade-off between cognitive distraction and the ability to induce state engagement. The visual elements might serve as cues during filling in of the memory tests.

Quantitative data are presented in Tables 1 and 2. Regarding knowledge outcomes, there was no difference in transfer tests ($t(76) = 0.57$; $p = .572$; $d = 0.13$; 95% CI [-0.32, 0.58]; with correction for pretest: $F(1, 75) = 0.16$, $p = .687$, $\eta^2 = 0.002$, 95% CI [0.00, 0.03][4]), but there was a moderate difference regarding retention tests ($t(76) = 2.19$; $p = .031$; $d = 0.50$; 95% CI [0.04, 0.96]) in favor of the E condition, which reduced to small, marginally significant difference after correcting for pretest scores ($F(1, 75) = 2.85$, $p = .095$, $\eta^2 = 0.038$, 95% CI [0.00, 0.18]).

[4] Confidence intervals in that case were computed using bootstrapping (N=1000).

**Table 1:** Means, SDs, and effect sizes for the retention and transfer tests.

[a]Uncorrected for pretest scores.

| | E | | N | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *d*[a] | *95% CI* |
| Retention | 11.71 | 3.07 | 10.07 | 3.50 | 0.50 | [0.04, 0.96] |
| Transfer | 6.29 | 2.23 | 5.98 | 2.49 | 0.13 | [-0.32, 0.58] |

**Table 2:** Means, SDs, and effect sizes for the affective variables.

[a]Scale 0 – 7. Higher values mean "more".
[b]Scale 10 – 50. Higher values mean "more".
[c]Scale 21 – 74 after the transformation through T-norms. Higher values mean "more".

| | E | | N | | | |
|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *d* | *95% CI* |
| Learning[a] | 5.17 | 0.91 | 5.09 | 1.12 | 0.08 | [-0.38, 0.53] |
| Usefulness[a] | 5.12 | 1.49 | 5.35 | 1.40 | -0.16 | [-0.61, 0.29] |
| Interest[a] | 5.44 | 1.15 | 5.47 | 0.81 | -0.03 | [-0.49, 0.42] |
| Motivation[a] | 6.27 | 1.00 | 6.24 | 0.95 | 0.03 | [-0.43, 0.48] |
| Difficulty[a] | 1.88 | 1.90 | 1.46 | 1.17 | 0.26 | [-0.19, 0.72] |
| Friendliness[a] | 6.27 | 0.87 | 6.27 | 0.65 | 0.00 | [-0.45, 0.45] |
| PANAS1+[b] | 27.74 | 5.50 | 28.28 | 6.21 | -0.09 | [-0.54, 0.36] |
| PANAS1-[b] | 15.94 | 5.06 | 16.95 | 5.46 | -0.19 | [-0.64, 0.26] |
| PANAS2+[b] | 30.23 | 6.54 | 30.91 | 7.15 | -0.10 | [-0.55, 0.35] |
| PANAS2-[b] | 13.38 | 2.82 | 13.33 | 3.33 | 0.02 | [-0.44, 0.47] |
| Flow[c] | 54.10 | 6.36 | 55.26 | 8.17 | -0.16 | [-0.61, 0.29] |
| PANAS+ diff | 2.71 | 5.00 | 2.59 | 4.28 | 0.03 | [-0.43, 0.48] |
| PANAS- diff | -2.70 | 4.13 | -3.81 | 3.90 | 0.27 | [-0.19, 0.72] |

Regarding self-reported variables, no difference was significant (all *p*s > .1; Table 2). Differences between the first and the second presentation of the PANAS were significant for both positive ($t(71) = 4.85$, $p < .001$, $d = 0.78$, 95% CI [0.45, 1.10]) and negative scale ($t(73) = -6.90$, $p < .001$, $d = -1.11$, 95% CI [-1.44, -0.77]). Flow levels were relatively high in absolute terms: they were in the same range as in the case of a college sample with the same nationality interacting with a 2-3 hour long brewery educational simulation and nearly a standard deviation higher as in the case of high school students with the same nationality playing a complex, team-based educational game over 5 hours (Brom et al., submitted).

Considering all the data together, we conclude that both animation's versions induced state engagement, but to the same extent. Affectively, the "emotional" manipulations were too subtle to make noticeable changes (the possibility that effects of individual manipulations counterbalanced each other is improbable because there is no indication in the qualitative data that any manipulation influenced state engagement negatively). However, the funny elements may have a cognitive impact: the study's results are consistent with the idea that some of these elements might serve as cues for recalling the animation's content. Accordingly, the E version mildly enhanced superficial learning (as measured by retention tests), but the additional cues did not help in conceptual understanding of the whole process (which is not surprising). It is thus possible that certain supposedly emotional manipulations have actually direct cognitive impact, unmediated via increased state engagement. The study of Mayer and Estrella (2014) and to a lesser extent also the studies of Plass et al. (2014; Exp. 1) and Park et al. (2015) showed a larger impact of anthropomorphisms on retention than on transfer. Only the original study of Um et al. (2012) clearly demonstrated the impact on both types of knowledge outcomes. Our study also highlighted the possibility of distraction by overly funny elements (the fish), but in our particular case, the distraction was probably small or outweighed by positives of the element's abilities to serve as a cue – because no decrease in knowledge outcomes was detected.

We can conclude that Hypothesis 1 has not been supported by the data. Hypothesis 2 was partly supported: regarding retention tests (with small effect size). Because there was no effect of the enhanced graphical appearance on state engagement, we cannot investigate its role in mediating the influence of the enhanced graphics on learning outcomes (i.e., Hypothesis 3).

## 5. Conclusion and limitations

This study investigated the effects of funny graphics and static anthropomorphisms on state engagement and learning outcomes in the context of a 6-minute-long, black-and-white, instructional animation. In general, the graphics in the "emotionally" enhanced version were viewed as positive, funny, accurate, and not distracting (perhaps with the exception of one element – the funny, mutated fish – for some participants). Yet the manipulation of the graphics was too subtle to yield measurable between-group differences regarding state engagement (indexed by generalized positive affect and flow level) and regarding deep conceptual learning (assessed by transfer tests). Only a small effect was found as concerns superficial learning (assessed by retention tests). At the same time, the learning experience induced state engagement in both groups.

Our finding is similar to what has been reported by Mayer and Estrella (2014) (anthropomorphisms in combination with warm, bright colors vs. schematic, black-and-white graphics), Plass et al., (2014; Exp. 1) (warm-bright-color anthropomorphisms vs. grey-scale, non-anthropomorphic graphics), Park et al. (2015) (warm-bright-color anthropomorphisms vs. warm, bright colors with round shapes, but no anthropomorphisms), and Snetsinger and Grabowski (1993) (funny appearance vs. neutral appearance). In fact, to our knowledge, only Um et al. (2012) demonstrated clear effects of emotional enhancements, warm-bright-color anthropomorphisms in their case, both in affective an cognitive terms, and on both comprehension and deep conceptual learning. In addition, Plass and colleagues (2014; Exp. 2) showed a positive effect of anthropomorphisms on comprehension, but only grey-scale (and not warm-bright-color) anthropomorphisms had positive effect on transfer.

In terms of our explanatory framework, CATLM, state engagement of the participants in the "enhanced" graphics group probably did not increase notably. Therefore, allocated cognitive resources did not increase notably, and, as a consequence, learning was not much enhanced: especially not deep, conceptual learning. Because we made three graphical alterations (rather than just one), it is, in theory, possible that a positive effect of a particular element was counterbalanced by a negative effect of a different element. However, there is no support for this explanation in the qualitative data. Therefore, we opt for the former, more parsimonious, explanation.

A primary practical implication of this study is that, as concerns instructional animations, adding black-and-white, static faces to otherwise non-human graphical elements and changing a few black-and-white elements to appear slightly more funny is probably not a big deal for high school (~ 17 years old) learners. The open question is the following: what would be a big deal? Given the importance of affective states in academic and achievement contexts, research to answer this question is much needed. One option is addition of color. However, as the results of Heidig and colleagues (2015) showed, color alone might also make no difference (i.e., if color is used to increase appeal, not for signaling purposes) (see also Plass et al., 2014, Exp. 2, for somewhat mixed findings). A combination of color and other features may be an option, as suggested by the work of Um and colleagues (2012), but this finding was only partially replicated (Plass et al., 2014, Exp. 1; i.e., for positive affect and comprehension but not for transfer; Mayer & Estrella, 2014; i.e., for comprehension only). One study demonstrated the highest effects on transfer for gray-scale rather than warm-bright-color anthropomorphisms (Plass et al., 2014, Exp. 2). More expressive anthropomorphisms may also be an option, but researchers will probably have to start looking beyond anthropomorphisms and funny appearances when searching for robust emotional design principles, for instance, on adding sophisticated game-based forms of interactivity (cf. Plass & Kaplan, 2015, pp. 139-142).

This also has a methodological implication. Studies investigating what role state engagement plays in enhancing learning would need to find more robust manipulations than those discussed here.

A theoretical implication of this study is that the impact of a graphical manipulation on learning outcomes, even if it is supposed to be mediated via state engagement, may be of cognitive nature. The only notable effect of our "enhanced" graphics was on retention tests scores, i.e., on rote memorizing what the materials were about. Better cues may help in recalling this content, and our qualitative data suggested that some of the "enhanced" elements actually might serve as such cues (whereas, these cues might not aid in deep, conceptual learning). In the future, it would also be useful to consider, in emotional design studies, the possibility that the manipulation in question may have a direct (i.e., unmediated via increased state engagement) effect on learning. Park and colleagues (2015) showed that expressive anthropomorphisms can grab learners' attention (as demonstrated by eye tracking data) without changing state engagement; but with a facilitative effect on comprehension, when the learning experience is preceded by a mood induction procedure.

Finally, this study is not without limitations, and so the above interpretations should be treated cautiously. First, this was a quasi-experimental study only. Participants were not randomly assigned to conditions and we cannot exclude the possibility that slightly different participant groups arrived to our conditions (the recruitment process was the same, but the two groups were investigated at different times of the year). Second, the neutral graphics group came from a different experiment. Thus, we did not have the opportunity to ask the N group participants in the interview the same questions that we asked the E group learners. For instance, the E group participants considered the "enhanced" graphics funny. Is it possible that the N group participants would also have considered the neutral graphical images funny, even if these images were not supposed to be? Third, even if a sample size of around 30 participants per cell is not atypical in the context of educational intervention research, the present sample size, i.e., 41 + 37, is actually relatively small (as also apparent from large confidence intervals for effect sizes). The study could thus miss a true difference with a small effect size.

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# MOOCs: The Promise of Meeting the Need of Flexibility for the Adult Learner?

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**Abstract:** In line with the emergence of MOOCs, the expectations of students' ability to conduct their own learning processes emerged emphasising the advantages of flexibility in time and space; a promise of meeting the needs for the adult learner (Knowles, 1972). In this paper we discuss which student roles emerge from this setting. In previous work, we pointed out challenges regarding teacher roles and how different knowledge domains influence the educational design of learning activities (Andreasen and Buhl, 2015). Reflecting on preliminary results from an international collaborative research project on MOOCs in Asia and Europe, we noted that many of the examined MOOCs were developed in relation to national issues of solving local educational challenges combining local instructional designs with the overall vision of user flexibility. Online learning activities has often in general been divided between either facilitating communities of learning or supporting individual and independent study, but initiatives of combining these approaches are evolving (Anderson, 2008). Likewise, the concepts of e.g. instructional design, didactic design, and learning design have different roots, but may in their current use overlap and offer new possibilities of thinking educational development (Mor et al., 2015). This paper further examines the diversity of learning activities in MOOCs, with an empirical basis in 12 case studies on MOOCs in Asia and Europe (Kim, 2015) pointing at how instances of 'self-directed learning' are orchestrated in various ways?

**Keywords:** self-directed learning, MOOCs, learning design, flexibility, adult learner

## 1. Introduction

This paper addresses the difficulties of designing for learning in ways that actually support the learners' activities in large scale courses like MOOCs, massive open online courses. Many activities in MOOCs look similar to e-learning activities, and many questions of curriculum, learning designs can be dealt with from similar theoretical approaches. However, by being massive, MOOCs make a significant difference. The upscaling of classical pedagogical questions of the what?, the how?, the why?, and not least the whom? to work for an audience of thousands of potential learners with different languages, different educational backgrounds, and different learning cultures, adds a new perspective to the pedagogical discussions of e-learning. Furthermore, an approach that focuses on how to engage with MOOCs on a governmental level nationally in order to find a solution to a huge educational challenge of the population, is different from an approach where a business model of MOOCs is the main effort behind the course design. Both of these approaches as well as those in-between promise the learner flexibility - like previous e-learning models have done over the years.

In line with the emergence of MOOCs, the expectations of students' ability to conduct their own learning processes emerged emphasising the advantages of flexibility in time and space; a promise of meeting the needs of the adult learner, like Knowles (1972) already stated years ago. But how can student participation actually be practiced in MOOCs, when learning experiences gained from previous education are placed in a large scale setting of a digital learning environment? This paper discusses the kind of student roles that emerge from this setting. In previous work, we pointed out challenges regarding teacher roles and how different knowledge domains influence the educational design of learning activities (Andreasen and Buhl, 2015). Reflecting on preliminary results from an international collaborative research project on MOOCs in Asia and Europe, we noted that many of the examined MOOCs were developed not with a global orientation, but in relation to national issues of solving local educational challenges combining local instructional designs with the overall vision of user flexibility. Similar to the identified 'c'- and 'x'-divide in relation to MOOCs (reflecting a mainly 'connectivist' or 'behaviourist' approach), online learning activities has often in general been divided between either facilitating communities of learning or supporting individual and independent study, but initiatives of combining these approaches are evolving (Anderson, 2008). Likewise, the concepts of e.g. instructional design, didactic design, and learning design have different roots, but may in their current use overlap and offer new possibilities of thinking educational development (Mor et al., 2015).

This paper further examines the diversity of learning activities in MOOCs, empirically based on 12 case studies on MOOCs in Asia and Europe (Kim, 2015). Our main focus is what the promise of MOOCs is to the learner when suggesting flexibility in time, space and pace as an attractive alternative to conventional settings of education?

## 2. Theoretical approaches

Drawing on a concept of self-directed learning, theories from Knowles and further developments are discussed, emphasising as well learner autonomy as the learning context, bearing in mind that self-directed learning requires support, e.g. through various approaches to learning design.

### 2.1 The adult self-directed learner

When Knowles introduced his ideas of the self-directed learner (e.g. 1972), he predicted an educational development which has later become huge: lifelong learning. Though he mentioned computing as a developed skill of the adult learner, Knowles could not predict the direction computer-based education has taken. What he addressed in his working paper was three assumptions: *the first assumption* dealt with which competences the adult needed for performing the various roles in life. He proposed a first draft of a taxonomy that included the roles of the adult as: a learner, being a self, a friend, a citizen, a family member, a worker and a leisure-time user. To engage in that, *the second assumption* was that the ultimate behavioural goal of schooling would be that: "the individual engages efficiently in collaborative self-directed inquiry in self-actualizing directions" (Knowles, 1972, p. 4). The ability to do that derived from seven skills including: the ability to develop curiosity; the ability to formulate questions; the ability to identify required data and locate and select relevant and reliable sources; the ability to organise, analyse, and evaluate data and generalise, apply and communicate the answers to the questions raised (ibid). *His third assumption* was that the goal of schooling would best be reached by organizing the curriculum as series of individual or collaborative learning projects, and by the school being understood as a "learning resource center" and the teachers as "learning project consultants" (Knowles, 1972, p. 5).

Knowles suggested that this spiral of learning projects throughout schooling would gradually mature the learner from an early stage of roles like friend, family member, and leisure-time user with an increasing complexity towards the unique self, citizen and worker. His idea was that the learner would gradually become more and more proactive and widen her circles into the community. He finalised his visualisation of the learner by describing the roles of the learning project consultant (i.e. the teacher) as the analyser of the learning experience. This should support the learner in becoming more and more self-directed - not motivated by graduation or formalised in adult education. There would be only lifelong education. More than 25 years later the results of his further elaboration on the subject (Knowles et al., 1998) showed refined descriptions of what has become core principles in andragogy: the learners' need to know, self-directed learning, prior experience of the learner, readiness to learn, orientation to learning and problem solving, and motivation to learn. These principles reflect the adult learner's personal autonomy as the goal for educators to facilitate, which refers to the three assumptions proposed in his working paper (Knowles, 1972), but are maybe more oriented towards a professional competence perspective than a personal competence. Knowles' vision of the self-directed learner in a lifelong perspective from 1972 has the beauty of being holistic and driven by intrinsic motivation. It shows certain parallels to the visions of the connectivist cMOOC movement where the world became the never ending possibility of net-based "widening communities". His vision of teachers as "learning project consultants" conjures associations to a MOOC crew of learning designers, the supporting tutors/teaching assistants and technical supporters offering curricula and organised facilities for interaction and evaluation.

Knowles' three assumptions could be recognised as the content of a lifelong learning design: what should be learned, how it should be learned and why it should be learned. But his vision is based on the starting point that the ability of being self-directed should gradually be implemented from the early years in order to prepare the learner to be 'self-propelled'. This may be helped along through the scaffolding of the learning consultant who in Knowles' perspective is a person who evaluates and diagnoses the next steps of progression and over time withdraws from this role and hands over this competence to the learner herself. Knowles' ideas of maturing may give associations to Piaget's cognitive models of development, and his spiral to Bruner's spiral curriculum theory; both authors are some of the theoreticians he refers to in his working paper; and relevant criticism of this idea of linear maturing can be made from the perspective of social constructivism. Newer perspectives made by his successors (Knowles et al., 1998) point at the learners' diverse prerequisites as an obstacle to attain the necessary personal autonomy for a self-directed learning progression. However, Knowles' take on academic progression as an ability that should both be embodied and trained over time including the practice of divergent and analytical thinking, may add valuable contributions to elaborate on current methodic suggestions of self-directed learning.

In newer discussions of self-directed learning, both learner autonomy and the learning context are seen as important components of self-directed learning. Paul Bouchard examines the various factors that constitute self-directed learners' autonomous learning strategies (Bouchard, 2009). However, as Garrison notes, looking only at the dimension of learner autonomy is not sufficient when understanding self-directed learning, especially in relation to implementing self-directed learning in an educational setting (Garrison, 1997, p. 18). Bouchard also highlights – apart from the autonomy of the learner – both the learning environment, the learning context, and the connections people make while learning as decisive factors for the success of self-directed learning journeys (Bouchard, 2009). Complex tasks such as formulating goals, or finding appropriate resources, can easily become overwhelming for the unprepared, and Bouchard points out that self-directed learning should be supported. We should not be "expecting from employees that they know without providing appropriate support for acquiring the knowledge" (Bouchard, 2009, p. 18). Thus, self-directed learning is not only a question of the autonomy to choose between already laid-out tasks, but to use various tasks and activities in supporting the learner's critical thinking and meaning-making: "An adult learner who is fully self-directed has moved beyond simple task control and has learned to think critically and construct meaning in ill-defined and complex content areas" (Garrison, 1997, p. 21).

In a study on self-directed learning especially in relation to Massive Open Online Courses, Kop and Fournier investigated which challenges and opportunities self-directed learners face when participating in connectivist learning environments (cf. cMOOCs), and found that these environments add new dimensions to the understanding of self-directed learning. These new dimensions comprise among other things the ability to thrive in a changing and chaotic environment with an overwhelmingly amount of possible resources (Kop and Fournier, 2010, p. 17). "Agency and activity are required in an autonomous learning environment, but it was clear that learners have their own ideas on what type of activities would suit them and their lifestyles, which might not necessarily be the same as those of the course organizers" (Kop and Fournier, 2010, p. 16). In the studied case, a large group of silent participants who did not produce artefacts nor participate extensively in discussions, nevertheless felt that they were actively engaged in the course through other activities like aggregating information, relating it to earlier experiences ('remixing'), and sharing it with others.

Seeing learning as a change process, Kop and Fournier notes in relation to the level of students' participation in MOOC activities, that "novices might need more time for this change process to occur, especially in relation to building self-confidence and a sense of community in such a large course" (Kop and Fournier, 2010, p. 13).

Kop and Fournier argue, in line with Bouchard's points above, that advocating self-directed learning is not synonymous with depending solely on the learners' immediate choices. In order to succeed, self-directed learners need facilitation and support for their self-directed learning processes: "Heightening the level of engagement and active participation is one of the main challenges of learning in an open networked environment and one in which educators could play a role" (Kop and Fournier, 2010, p. 17). What should be kept in mind is that the learning context may invite to learners' engagement and participation in various ways. As D.R. Garrison points out, "[t]he challenge for teachers is to create the educational conditions that will facilitate self-direction" (Garrison, 1997, p. 30).

Knowles' approach to self-directed learning (Knowles, 1972) is based on knowledge creation as an active inquiry building on question processing skills and searching for relevant sources to answer the questions. We argue that his proposed flexibility refers to self-directedness in the process of knowledge creation. We further argue that this approach differs from seeing self-directedness only in the meaning of flexibility in time, space and pace. We assume that this differentiation may have implications for the extent to which MOOC participants are capable of completing a course. The development of the ability to actually act and learn on the basis of a chosen direction of decisions connected to knowledge creation is a highly complex and delicate ability, which must be developed over time supported by a professional educational consultant (in Knowles' terms: a learning project consultant). The origin of self-direction occurred in a pre-MOOC context where the consultancy would be conducted face-to-face and in a local physical environment. Our analysis of the 12 cases below aims to reveal the various orchestrations of self-directed learning and how the students' activities are scaffolded and related to conceptions of learning design.

### 2.2 Conceptual approaches to learning design supporting learners

Drawing on issues from creating an e-learning environment, Anderson suggests that not one theoretical position may serve as the foundation for creating adequate learning situations (Anderson, 2008). Learning design may draw on different theoretical frameworks, and practical design decisions may be informed by that. From a theoretical point of view, identification of either behaviourist, cognitive, connectivist or social constructivist positions may be suitable to frame a MOOC, or to label a MOOC already designed. But from a position of the educator's scaffolding of learning activities suitable for the learners' prerequisites, it may not be a choice of either or. MOOCs urge us to discuss it from the large scale perspective where an automation of scaffolding activities are used to either organise, practice or evaluate the learner.

Still, there are conceptual ideas of the learner and the learning process that prescribes the underlying framing of learning objective. Mor et al. (2015) describes learning design as a many-faceted concept which develops along with conceptual developments of instructional design. The authors acknowledge the confusions among practitioners and researchers because the two concepts of learning design and instructional design at the outset represent different pedagogical ideas. While learning design refers to constructivist theory and connects to technology-enhanced learning in the 1990s and 2000s, instructional design refers to behaviourist theory and goes back to the Second World War, where a rapid training of technical skills for the production of war materials was needed. However, nowadays the concepts are developed and used in a manner where the two domains overlap, and the distinction between them seems difficult to maintain.

Along with the emergence of ICT, discussions of the relations between technology and didactics drawing on theoretical frameworks that emerge from the Nordic tradition, seeing technology as being more than an added tool, develop among scholars working with technology (e.g., Andreasen, Meyer and Ratleff, 2008; Holm Sørensen, Audon and Levinsen, 2010; Meyer, 2011), emphasizing the constructivist-pragmatic approach in a technological landscape, which expands and changes the perception of time and space as well as access to information and knowledge construction, the framing of social practices, and the conditions for societal think patterns.

Together with the suggested perspective in Mor et al. (2015), where the conceptual approaches of learning design and instructional design both offer overlaps and gaps in the literature, diverse vocabularies and terminologies rooted in different scientific traditions seem to be occupied with the same theoretical issues regarding planning and practicing education. The turning and shared point among the diverse suggestions "learning," "instructional," "educational," "didactic", etc., is their conceptual connection to *design*. From our point of view, the concept of design indicates a development where continental currents of didactics and Anglo-Saxon currents share issues connected to the theoretical as well as the operational part of education, which faces a set of new challenges (Buhl, 2016). Design indicates a paradigmatic shift in the role of the educator's conditions for reflecting on, choosing, and planning learning activities. With regard to MOOCs and the upscaling of learners addressed, the educator may have to involve other actors in her organizing processes; she will have to think of how learning processes can be facilitated without the actual presence of her as a teacher, and she may have to negotiate the succession of learning objectives with the learners; she may also have to plan learning activities for learners she will never meet with. In addition, she will have to decide how to induct students with diverse educational backgrounds into new scientific domains, etc.

## 3. Empirical data

The empirical data to be discussed in this paper are retrieved from a collaborative project reporting on educational challenges in relations to MOOCs (Kim, 2015). In the collaborative project, twelve mainly country-specific studies on the development of MOOCs were carried out, pointing out general tendencies as well as presenting specific cases. The following discussion builds on these reported studies, which represent diverse scientific communities and academic styles. Furthermore, the joined task of reporting on MOOC endeavours is approached in different ways. Still, we find that the cases provide ideas of flexibility in self-directed learning and how difficult a "one-fits-all" concept is to realize.

Considering the reported cases from one perspective, a MOOC is a governmental investment to increase the national level of education (India, Thailand, China, Korea, Philippines, Malaysia, Spain and Latvia). From another perspective MOOC is the next step in a technological evolution to enhance an ongoing development of open university offers, where MOOCs are regarded to be the new development (Korea, Thailand, Malaysia, Spain, Japan). One case engages with MOOCs on a local level creating a course for another country (Denmark, with a MOOC aimed at Indonesian child-care-givers), while two other cases discuss MOOCs with regard to an ongoing endeavour of increasing the use of technology-enhanced learning in higher education as such (Latvia, Slovakia). The differences are not surprising taking into account the diverse educational conditions on a political as well as a practical level.

Our analysis of the cases is structured through four key questions which serve to inform the approach to the learning process from the perspective of the promise of flexibility. The questions are:

- How can student participation be practiced in the MOOCs?
- Which student roles emerge from these settings?
- Which diversity of learning approaches are presented?
- How are local instructional designs combined with the overall vision of user flexibility?

In the following, we will present how the key questions are actualised in the 12 cases.

### 3.1 How can student participation be practiced in the MOOCs?

The practice of student participation takes different forms in the cases. MOOCs seem to express a promise of increased interaction between students when engaging with learning activities. Several cases report on interaction as a new promising achievement emerging from MOOCs enhancing the students' learning processes. They are referred to as services available as "gathering places" (China), "social networking services" (Japan), but also as "discussion forums" and "focus groups" (Philippines, Malaysia, Denmark). The cases report no further elaboration on the theoretical basis for the ideas of practices of interaction apart from the Danish case which draws on Salmon's E-tivities approach to structure students' reflections through use of regular peer assessment activities. Thus, the reporting on interaction may represent activities ranging from Q&A's, quizzes, self-study activities implying a teacher or a system as the other part of the interaction process, as well as group discussions where students function as each other's peers.

A MOOC's up-scaled number of participants in one online community requires some sort of scaffolding to enhance social interaction forms for course learning (Bouchard, 2009). The Chinese case shows an interesting development where a gathering place across courses (for 40.000 learners) emerged from a student-initiated need for discussion *besides* the pre-planned course activities. This shows the necessity for facilitating the social part of learning, an assumption which is supported by a student/teacher evaluation in the Latvian case criticizing MOOC for the lack of interaction.

### 3.2 Which student roles emerge from these settings?

The promise of flexibility demands a student who possesses both scholarly skills to maneuver the digital learning content and learning paths and social skills to engage with other students. Bouchard (2009) points out that these are complex skills to achieve, and this will especially apply to novices who access a MOOC for the first time. The various cases report interpretations of the student role from the perspective of individuality and mostly aimed at responding to defined assignments followed by self-checks (Japan, Malaysia, Latvia, Slovakia). The Spanish, Danish and Philippine cases report peer activities and communication among students supplementing the individual activities. In all cases there are indications of a very individualized student profile and of an idea that flexibility equals first and foremost a temporal and spatial freedom to access learning resources. The cMOOC idea of establishing a collaborating community where students engage in learning (Andreasen and Buhl, 2015) cannot be traced in the reports. Most reports indicate the role of a student to be rather a *knowledge consumer* than a *knowledge producer*. Some cases report that students can study together, which is mostly described in terms of accessibility to communities where the students can take on an independent approach to work with knowledge generation drawing on the resources available.

### 3.3 Which diversity of learning approaches are presented?

Promising flexibility gives rise to expectations of offering a diversity of learning activities. MOOCs may promote not only a many-faceted range of resources for learning, but also many-faceted ways of learning. Most of the reported cases report on the diversity as a diversity of accessible resources through supplementing traditional written material with for instance video lectures (India, Malaysia, Denmark, Spain, Philippines, Slovakia, Latvia).

This is not surprising since video lectures may be seen as the obvious compensation for the traditional teacher. This also indicates that most MOOCs have not so far stimulated development of new learning activities. One might even suggest that they in some ways seem to step back to former conventional lecture forms and are unable to implement recent developments from e-learning programs facilitating more interactive learning forms. The upscaling of the number of students seems to be a constraint to learning activities beyond conventional ways of teaching. When the traditional teacher-student relation vanishes, this relation must find new forms. Knowles emphasized the relation between teacher and learner as the core for development of the skills to be self-directed. Results from an evaluation workshop in the Korean case show that the students need the practices of this relation and that they ask for a facilitation at all didactic levels: learning content, organisation of learning processes, moderation of interaction.

### 3.4 How are local instructional designs combined with the overall vision of user flexibility?

In consequence of the overall vision of user flexibility, most of the analysed cases focus on content organization and accessibility in time when describing learning designs. As Bouchard (2009) points out, complex tasks such as formulating goals, or finding appropriate resources, can easily become overwhelming for the unprepared, so that self-directed learning should be supported, and lessons are learned about how different facilitating and moderating strategies must be integrated in the learning design to make a successful e-learning programme (Anderson, 2008). Even though the relations between educator, student and content is the classic approach to issues concerning learning design, MOOCs in the studied cases seem to promote the content-organizing aspects (India, China, Japan, Korea, Malaysia, Latvia, Philippines, Denmark, Spain). The facilitation of how to approach the learning content, how to engage the student, and which ways to achieve knowledge are scarcely touched upon in the reports from the cases. The behaviourist idea of knowledge transmission is prevailing, and connectivist or constructivist ideas of learning appear only in three cases (Spain, Japan, Denmark). An interesting observation is the Japanese idea of the video lecturing teacher replaced by an avatar. Other observations are the idea of distributing the content development to different actors (Malaysia). The design of the learning situation revolves around content which refers to an idea of education as a material formation process (Klafki, 1985). It seems that the endeavour of appealing to the self-directed learner leaves reflection of the support of the learner (the educator) and the conditions of the learner behind.

## 4. Self-directed learner? Or self-directed learning? How can the need for flexibility be met?

From an overall discussion of the cases, the major challenge is the orchestration of self- directed learning processes in the sense addressed by Knowles (1972, 1998) and Bouchard (2009). Several reports address self-directed learning as a matter of choosing between resources or attain flexibility in time, space or pace (Korea, Malaysia, Philippines, Thailand, Slovakia). The expectations expressed in the cases towards the learners' capability to be one's own learning designer and being able to make the right content choices, selecting relevant literature and pose and work with relevant questions does not indicate a self-directed learner in the way Knowles envisioned it. Rather the cases indicate a learner that can choose between ready-made packages of instructions.

Knowles' idea of knowledge creation as an active inquiry of question processing skills and of searching for relevant sources to answer the questions cannot be traced in the reports, and the question of flexibility remains a flexibility in access to resources and a flexibility in time, space, and pace. Bouchard's (2009) and Garrison's (1997) emphasis on both autonomy of the learner, the learning environment, the learning context, and the connections people make while learning as decisive factors for the success of self-directed learning journeys are important issues when engaging with MOOCs. The studied cases expose the difficulty of dealing with the *upscaling* issue combined with a digital environment. So far the solution is found in drawing on ideas of self-direction in a way where the choices are choices of packages for knowledge transmission rather than resources for knowledge construction.

Anderson suggested that "a learner-centered context is not one in which whims and peculiarities of each individual learner are slavishly catered to" (2008, p. 47). Instead he argued that it is a context that meets not only the need of the learner, but the need of the teacher, the institution, and the society as such. He even suggested that it should be labelled learning-centred as opposed to learner-centred to emphasise that point. His argument may be further interpreted stating that learning should focus on knowledge construction and ways to achieve knowledge as a project of inquiry (cf. Knowles) rather than choosing firmed packages from the shelf. Perhaps his distinction may have potential for the discussion of self-directed learning as well. The promise of flexibility lies not in the accessibility to a lot of opportunities, it lies in the capability to inquire and understand how to make use of the opportunities. Even though Kop and Fournier argue that learners have their own ideas on what type of activities that will suit them, and even though they experienced new ways of course participation, their study also showed that the process of engaging in a MOOC environment is chaotic and requires both self-confidence and community skills. Their study indicate what Knowles suggested in 1972: To be self-directed is the result of a long process which emerges over time from scaffolded practice.

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# Perception and Utilization of Facebook by University Students: Case Study

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**Abstract:** Interest in students learning engagement and utilization of social software applications forms the philosophical core of the long-term research which has been conducted at the Faculty of Informatics and Management, University of Hradec Králové within the frames of national and specific educational projects. Academicians are striving to reveal how students perceive and utilize new possibilities of Web 2.0 applications like social nets or learning management systems. The goal of this paper is to map real situation relating to utilization of social applications, in this case utilization and perception of Facebook with focus on students´ active engagement. As for the research tool, the survey with a questionnaire was applied with five groups of sixty-seven full-time students of Applied informatics, Information and Financial management bachelor study programmes. Utilization of Internet and social applications are connected with technological readiness. Social applications are seen in accordance with literature review in their features that enable a wide range of interaction, collaboration and sharing materials and ideas among users. But findings from our research are not so promising; surveys do not prove such students´ involvement and call for further discussion. Findings show that 94 % of students sample use Facebook for both personal and study purposes. But less than half of them can see potential in Facebook.

**Keywords:** Facebook, social media, collaboration, university students, case study

## 1. Introduction

Virtual space has been giving our real world new dimension; creativity and innovations are valued characteristics. Web 2.0 is characterized by wide range of Social software applications (SSA) which fit knowledge. Technical innovations featuring substantive drive in young people hence university students as well enable users participate and interact in the Internet environment.

When students use SSA for study purposes it is obvious that they use them in everyday life, as well. If we look at that from a higher perspective, interconnection with wide areas can be explored as this may be reflected in advertising, product sales, track users etc. Students who get familiar with these applications will realize their benefits not only for private life, but also will be able to apply them in the business sphere. They will not be afraid to use them, they will be able to see their potential, and they will know how to move in them, behave and benefit from them.

*The paper contributes to the exploration of utilization of Web 2.0 phenomenon by university students of the second* year of Applied Informatics, Financial and Information Management studies within Bachelor Study Programs. Utilization of Web 2.0 is explored at two levels which often mingle: at the level of common use and at the level for *study purposes. Another key explored area is students´ activity; students´ voluntary and obligatory engagement into cooperation in Facebook environment is followed.*

The discussed topic of the role of social applications in the tertiary education with the focus on collaboration and cooperation as their key features has been highlighted and analysed in a wide range of highly professionally oriented papers, e.g. (Claros, Garmendía, 2014, Jovanov et al, 2014, Silapachote, Srisuphab, 2014). They were also sources of inspiration for our research and evaluation of findings. Papers repeatedly underlined the magic words of pedagogical effort which are 'engagement' and 'motivation' of students into learning process; how to get students engaged, how to motivate them and at the same time tailor the way of the educational process so that it could reflect current trends and foster the demands of the digital age of university students. The philosophical core of the long-term research which has been conducted at the Faculty of Informatics and Management within the frames of national and specific educational projects is 'interest in students´ learning engagement'. Researchers are striving to find out how students perceive and use the new possibilities of web applications brought by Web 2.0., e.g. utilization of SA for private and study purposes (Černá, Poulová, 2014). The broad concept was narrowed two years ago when we focused on the cooperative and collaborative feature of social applications (Černá, Svobodová, 2014). The issue of cooperation and collaboration has been discussed by academia (Valtonen, 2011, Weller et al, 2010). *The paper brings current data on the issue of real active involvement of students into utilization of one of the monitored applications, in this case into utilization of Facebook in local university setting.*

Following subsections deal with individual key terms as they are rather complex: Web 2.0 concept and web application, social media and social network.

### 1.1 Web 2.0 concept and web application

Web 2.0 concept was defined by Tim O'Reilly in MediaLive International in 2004 as a designation of the new generation of the Web. Reilyho definition of Web 2.0 is as follows: "Web 2.0 is the business revolution in the computer industry, which is caused by deflection in the understanding of the Web as a platform. Key among those rules is this: build applications that will get better due to the network effect with an increasing number of people." Tim O'Reilly (2005) defined the main differences between classical Web site and a new generation web. In terms of software development Web 2.0 is characterized as a shift from centralized processing and services to decentralization. The 2nd generation web gave users the ability to handle their website and use social networks to converge with other users and attract potential customers (commercial use).

For the purposes of our research a shortened definition of Web 2.0 was selected: '*Web 2.0 is a term for applications, where the user communicates with other users and he/she affects the content*'.

An application is a key term that runs through the paper that is why definitions are provided. "A web application is any application that uses a web browser as a client. The application can be as simple as a message board or a guest sign-in book on a website, or as complex as a word processor or a spreadsheet." (Nations, 2016). The term may also mean "a computer software application that is coded in a browser-supported programming language and reliant on a common web browser to render the application executable." (Thefreedictionary) Application software is "a software designed to carry out a specific task or meet a specific user requirement; application programs collectively." (Oxforddictionaries)

### 1.2 Social media, social network and social networks geography

Social media refers to the means of interactions among people in which they create, share, and exchange information and ideas in virtual communities and networks. (Ahlqvist et al. 2008). Kaplan and Haenlein (2010) define social media as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content." Furthermore, social media depends on mobile and web-based technologies to create highly interactive platforms through which individuals and communities share, co-create, discuss, and modify user-generated content. It introduces substantial and pervasive changes to communication between organizations, communities, and individuals. (Kietzmann, 2011)

"Social network is a theoretical construct useful in the social sciences to study relationships between individuals, groups, organizations, or even entire societies (social units, see differentiation). The term is used to describe a social structure determined by such interactions." (Thefreedictionary)

In case of Web 2.0, social networking means any system that enables creation and maintenance of a group of interconnected contacts and friends. Even systems where creation of contacts isn´t their primary mission but only one of supported functions can be included into social networking. Each user of social networking system de-fines his/her characteristics and attributes, which are publicly available for other users. People within the system can mutually seek each other within the system and create virtual "community".

Geographical view of the distribution of social networks reflects a cultural difference in nations. *The largest share of the world map belongs to Facebook, which is located mainly in North and South America, Europe, Australia, India and North Africa.* (World map of social networks, 2016). Social network Vkontakte.ru is a popular throughout Russia and Russian speaking countries, social network Qzone is popular in China. Both social networks Vkontakte and Qzone serve as analogues to Facebook, including almost identical functions. Social network Facebook has such a wide representation in the world thanks to translations into 60 languages. *The most utilized network in the Czech Republic is Facebook.*

The organization of the paper is as follows: firstly a theoretical background with a review of the literature is provided. Then research methodology is described, the key part brings results from the survey which was run with 67 full time students from the Faculty of Informatics and Management, University of Hradec Králové this academic year. The highlighted analysed area is students´ utilization and expectation in the potential SSA and their enrichment of the virtual space with their contributions. Graphs and table visualize the findings. Conclusion summarizes the findings and raises questions calling for further discussion.

## 2. Literature review

This chapter brings literature review relating to the implementation of social applications into tertiary education. Researchers approach the issue of social applications into higher education from various perspectives. For example, Valtonen (2011) discusses social networking in the paper and brings implications for learning which are based on the findings from a conducted survey with more than one thousand students on their ICT skills and use of social software but from the perspective of a tutor. Tess (2013) examines the role of social media and their potential as a facilitator and enhancer of learning. As for learning/teaching languages new achievements in informatics are applied in new approaches (Čechová, Charbonneau-Gowdy, 2008). As for characteristics of Web 2.0 and its appropriateness for teaching-learning purposes, it encourages sharing and construction of information; it is participative. The most underlined potential is seen in cooperation and collaboration. Findings gained from the review prove strong belief in real active cooperation and sharing knowledge via social media. But our findings from previous surveys where mapping of awareness and utilization of selected social applications in higher education didn´t indicate students´ expectations of future utilization of social applications (Černá, Svobodová, 2014).

### 2.1 Brief statistical overview of the Czech Republic and the EU

Number of people who use social media is increasing; it is evident that social media role is increasing together with the impact on the process of education. Fig.2 illustrates common Internet users and social network users in the Czech Republic and in the European Union (Eurostat, 2016).

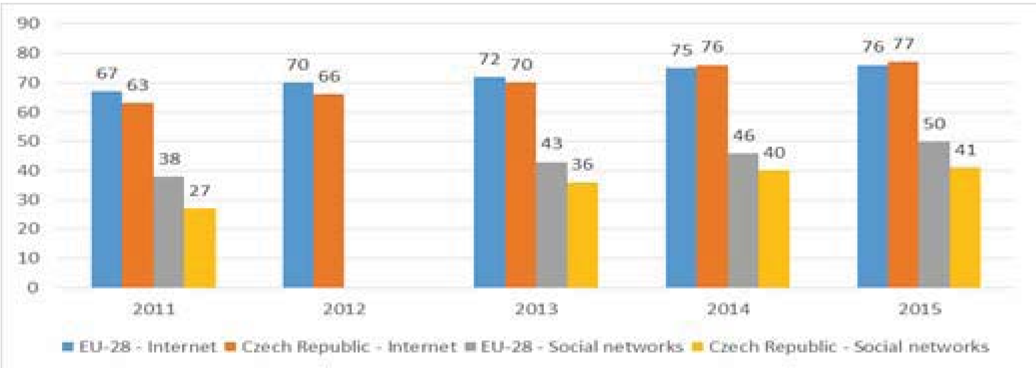


**Figure 2:** Ordinary users of the Internet and social networks in the EU-28 and the Czech Republic (in %), (Eurostat, 2016a, Eurostat, 2016b)

It can be seen that the Czech Republic was in percentage slightly behind the EU-28 in the use of the Internet in 2011-2013. In 2014 and 2015 the amount of people using the Internet increased by one percent. Regarding social networks, data from 2012 are not available. Even though the number of social networking users in the Czech Republic is growing like in the EU-28, the Czech Republic is still below the EU-28$^{th}$. During last rating, utilization of social networks in the Czech Republic was lower by 9%. Countries which use the Internet most to access the social network in 2015 in the EU-28 follow: Norway – 73%, Belgium – 67%, Great Britain – 66%, Denmark – 65%, Sweden – 62%, Hungary – 61%. Poland and Turkey reach the same figures. Only Italy and France with 38% and Slovenia with 37% are behind us (Eurostat, 2016).

According to the statistic report of 30 November 2015 population in the Czech Republic reached 10,538,275 inhabitants. On November 30, 2015 there were 8,400,059 Internet users, which meant 79.7% of the citizens. *More than half of the Internet users, to be precise there were 4.5 million citizens of the Czech Republic who had their Facebook account to 15 November 2015*. (Internetworldstats.com)

## 3. Research methodology

The study problem of the research and concise history of projects, research objectives, the research tool, the accessible sample and the way of data processing are discussed in this chapter.

Development of trends in acceptance, utilization and satisfaction with social applications in higher education on a limited scale of local university was monitored for five years within national educational projects 'Evaluation of the modern technologies contributing towards forming and development of university students' competences' and within a follow up Excellence project 'The ICT reflection within cognitive process development'.

- This current study is conducted within the frame of a new grant project "The influence of social media and mobile technologies on formation of optimal model of teaching".
- The paper is a logical continuation of the research dealing with social media landscape which concerned individual types of social applications selected on the basis of their various missions fitting various goals.
- The study problem deals with social media in tertiary education.

Two main areas are monitored:

- *students´ readiness to cooperate or even collaborate in the virtual space of social applications*
- *and their opinion in sense of expectations on potential of individual social software applications. This case-study is focused on utilization and perceived potential of Facebook by university students.*

The main objective of the paper is to accept or reject following hypotheses:

- "When the student sees potential in Facebook, he/she already uses it."
- "When the student can see potential in Facebook, they voluntarily insert their contributions."
- "When the student inserts contributions voluntarily, they will insert contributions on the basis of teacher's instructions ('compulsorily')."

The paper is based on *the survey followed by semi-directed discussions which were conducted with 67 sophomore students* of Applied Informatics, Information and Financial Management within the Professional English classes this winter semester. *Findings were discussed with students* during the following language classes. Discussion about the findings on social applications is a students´ topic because it is tightly connected with their life which is a proven activating factor. Students get engaged into the talk on a familiar topic even in a foreign language.

*As for the research tool, the survey with a modified questionnaire was applied*. The survey stems from a long term survey on utilization of fourteen SSA; this survey is based on a short list of eight relevant applications which are appropriate for cooperation and collaboration activities and enable development of common knowledge: Google+, Facebook, You Tube, Wiki, Skype, Blog, Social-bookmarking and a learning management system. Six areas of app´s utilization were examined: real use of the apps, use for study purposes, use for studying languages, and active involvement of students into enriching the app´s content by means of contributions placed both voluntarily and mandatorily – arising from teacher´s instructions and finally students´ belief in the potential of discussed applications. Instead of standard on-line questionnaire a rather old fashioned technique was applied; *67 hard copies of adapted questionnaires were distributed and collected*. It took about 10 minutes to fill in the questionnaire. *A follow-up discussion on SSA experience* took about 15 minutes. Both teacher and students made notes. Research accessible sample consisted of 67 full-time students from the University of Hradec Králové from the second year of their study. *100% return of the questionnaires* was guaranteed because *the whole process was run during language classes with the tutor.* This case-study reveals data from Facebook which is most widely utilized social network.

*As for the data processing,* cross tabulation was applied. Utilization of SA and their potential was compared via contingency tables. Technology Acceptance Model was used. It is a theoretical framework designed by Davis (1989) that proposes a relationship between users' acceptance of a new information system and the users' perceptions of the ease of use and usefulness of the information system.

## 4. Findings

All students who formed the research sample were of the similar background; age, time spent at the university, bachelor programme, full-time students of Applied Informatics, Financial, Information and Tourist management.

Firstly findings from the quantitative research are presented. This section brings a general view of Facebook in students´ common life, then use for study purposes, studying languages and expectations of potential for studying are solved.

The evaluation is described on the most often utilized application all over the world, on Facebook social network. An interesting fact is that in the examined sample of students, YouTube is used by all respondents.

Fig. 3 shows the key quantitative findings:

- 94% of respondents use Facebook,
- only 57% of respondents use Facebook for study purposes,
- utilization of Facebook in studying languages is even lower; the figure drops to only 40% of respondents.

Findings reveal that in spite of the fact that students widely use Facebook in everyday life the expected use for study purposes is significantly lower. Currently in the time of 'unlimited' virtual entry to foreign countries and to communication with ‘unlimited’ numbers of foreign friends the need of language competences is inevitable and Facebook is a promising tool for practising language.

So the first question arose: *Why Facebook is utilized for language study purposes only by 40% of respondents when the same respondents use YouTube for language purposes in nearly 90%?*

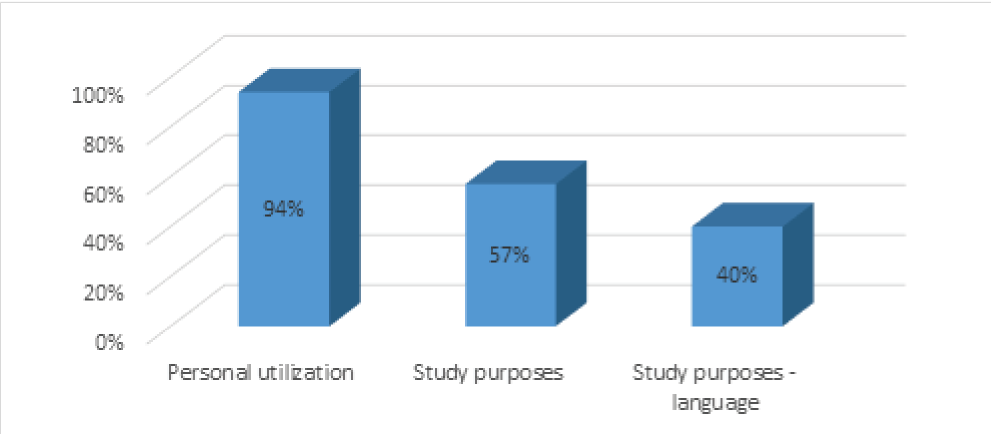


**Figure 3:** Facebook: use in personal life, use for study purposes and use for English language study by students of FIM, UHK (own processing)

Students’ opinions are valued so their opinion on the potential of Facebook for study purposes was examined. The findings on perceived Facebook potential are presented in the Fig. 4. together with the findings relating to students real activity enriching the content of this social network. Numbers of contributions which were placed by students into the social network both voluntarily and mandatorily on the basis of teacher’s instructions were monitored and consequently presented in Fig. 4.

- Only one fifth of respondents place contributions for study purposes into the social network on the basis of teacher´s instructions.
- Voluntary activity is much higher, 48% of respondents enrich the content and add contributions.
- Only 43% of students can see potential in Facebook for study purposes.

Here arose another question: *If 57% of respondents already use Facebook for study purposes why only 43% can see potential for study purposes in it?* Instantly another question arose*: Why is there decline also in the seen potential in YouTube? 91% of respondents use it for study purposes, 100% use it in everyday life but only 81% can see potential in it for study purposes? Why such scepticism?*

During a deeper analysis it was found out that 3 students who do not use Facebook can see potential in this app. Another question follows: *Why he/she doesn´t use it when he/she can see potential in it?*

But contrary, 35 Facebook users do not see potential for study purposes in this app. The question is why?

Only 26 respondents out of 67 use Facebook and find potential in it for study purposes.

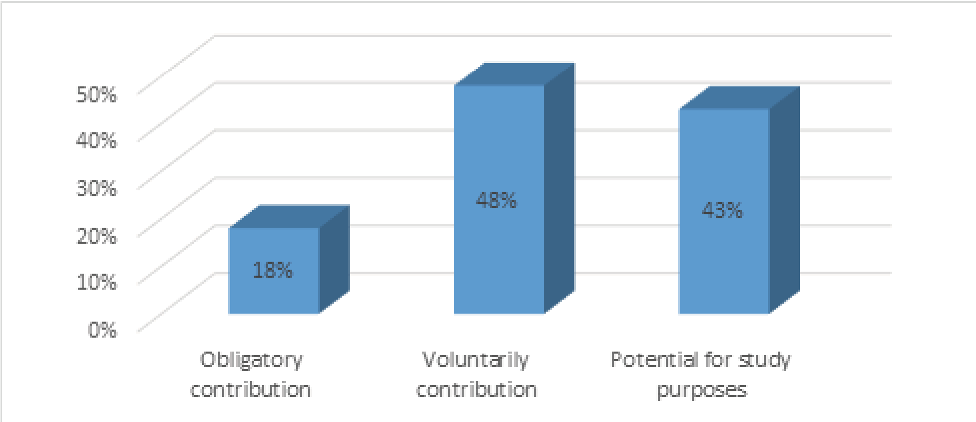


**Figure 4:** Facebook: inserting contributions into Facebook on the basis teachers´ instructions and on voluntary basis, seen potential of this application for study purposes (own processing)

In case that the evaluation of use and of the potential of selected social applications in education is conducted via other statistical methods, we can draw the following conclusions.

- Statistically significant consensus was found in case of a robust application in a Learning management system LMS (Cramer's V = 0.487, sig = 0.000).
- On the contrary, Facebook was found to be nearly zero and insignificant consensus (Cramer's V = 0.093, sig = 0.447) which means that the answers are inconsistent. The results derive from the total numbers of the 67 respondents where Facebook is employed by 63 students, 38 respondents use it to study, but only 29, which is less than half find the potential for learning.

The final part of quantitative findings analyses the issue from another statistical perspective, it brings findings which were gained from the comparison of students´ voluntary activity results in Facebook with perceived potential of Facebook for educational purposes in future, see Table 1.

**Table 1:** Results of voluntarily contributions and potential of Facebook (own processing)

| | | | FB_potential | | Total |
|---|---|---|---|---|---|
| | | | 0 | 1 | |
| FB_voluntarily | 0 | Count | 26 | **9** | 35 |
| | | Std. Residual | 1,4 | -1,6 | |
| | 1 | Count | **12** | 20 | 32 |
| | | Std. Residual | -1,4 | 1,7 | |
| Total | | Count | 38 | 29 | 67 |

Data were analysed in accordance with student´s field of studies, see Fig. 5. Students were divided into three groups. The first group called 'Informatics' consisted of 39 students of Information Management and Applied Informatics who were by equal shares: 19 students of Information Management and 20 students of Applied informatics. It could be expected that these students had an affinity to discussed technology and were not afraid to use them. The second group called 'Management' consisted of 11 students of Financial Management and one student of Tourism Management. Finally there were 16 students who didn´t mention their field of study into the questionnaire so the group was called 'Non-specified'.

- Concerning the results, paradoxically, 3 students of Informatics field of studies do not use Facebook.
- When it comes to utilization of Facebook for study purposes and for studying languages, non-Informatics students were more active when expressed in percentages.
- Students of informatics field contribute slightly more to the content of Facebook.

- Surprisingly, in spite of the fact that students of Financial and Tourism Management use Facebook for study purposes and for studying languages more than the group of Informatics students, those who can see greater potential are students of Informatics, more by 21%..

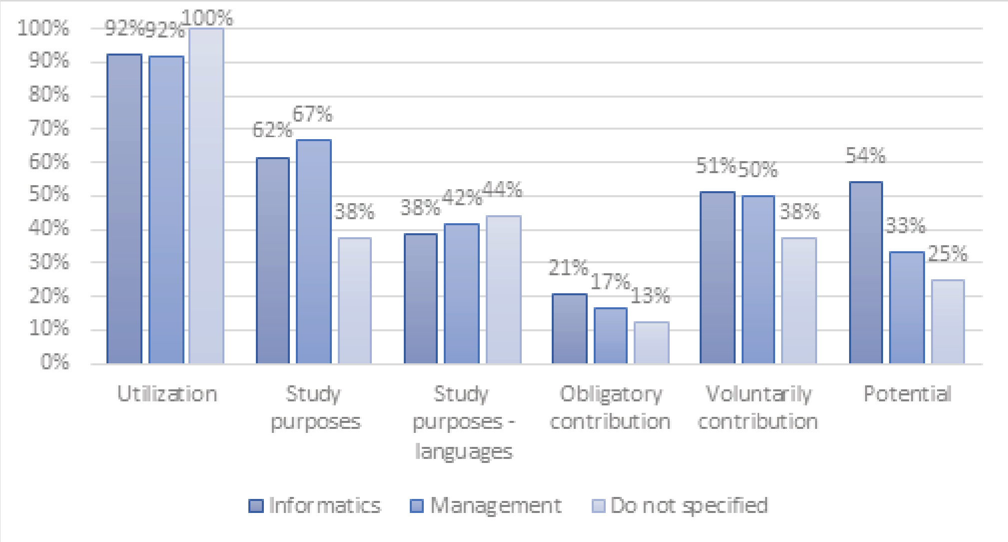


**Figure 5:** Utilization and potential of Facebook – comparison according to field of studies (own processing)

Notes on the *follow – up discussion* conclude this chapter on Findings. After filling in all parts of the questionnaire extra comments were added by active students. In spite of the fact that the main analysed application is Facebook several comments on dominant and most frequently utilized YouTube app are presented, as well. YouTube was most widely appreciated and discussed application with most comments on the questionnaire. Excerpts from submitted forms follow: e.g. *"In my opinion YouTube is an excellent thing."; "I definitely can see future in YouTube.*"; "*Thanks to videos we can comprehend everyth*ing *much better than from theorems."; "YouTube – those are videos and solutions – science, culture, the world*."

To summarize YouTube popularity, it might be stated that YouTube represents for students a kind of a world mosaic where visualization is of vital contribution.

As for Facebook comments, they are not so colourful. Students of this sample perceive this app as a common communication and information tool which is always at hand, standard utility of their lives which is on 24 hours a day. Selected citations of students´ statements follow, e.g. "*My First priority is Facebook.*"; "Solving Problems."; "Facebook is first response."; "I up-load/download plenty of materials there."

A question into discussion could be raised: *Why are students sceptical towards Facebook when those who use it are switched to it by day/by night*?

## 5. Discussion

Questions calling for further discussion have already been stated in the previous chapter as they formed a kind of a follow-up which complemented the gained findings.

The main rival of Facebook is YouTube. Most of questions reflect this fact.

- Why Facebook is utilized for language study purposes only by 40% of respondents when the same respondents use YouTube for language purposes in nearly 90%.
- Can Facebook with perceived potential reach the popularity of YouTube in the process of education?

*Scepticism* in the perceived potential was a rather unexpected finding.

It is clear that no generalisation can be done, when the research sample was limited to 67 respondents but findings bring implications that students´ view can differ from academicians´ view. It was proved that utilization of Internet and social applications are connected with technological readiness that all the sample of students is familiar with the discussed apps. But the belief in the strength in social applications which is defined by their features enabling a wide range of interaction, collaboration and sharing materials and ideas among users was not convincing. Belief in the potential of YouTube as the most prominent app is surprisingly also smaller than its current use for study purposes.

- Why is there decline also in the seen potential in YouTube? 91% of respondents use it for study purposes, 100% use it in everyday life but only 81% can see potential in it for study purposes?

Language teachers might appreciate satisfactory findings, because 90% of students use LMS for studying languages and 60% develop the content of language e-courses via voluntary and mandatory contributions. But there is also decline in the perceived potential only 75% students can see the potential for study purposes.

Future direction of the research might be conducted in the sphere of identifying the benefits of content-oriented networks compared to profile-oriented networks, which can lead to greater individualization in providing information and resources.

## 6. Conclusion

The goal of this paper was to map utilization of Facebook in a wide sense of everyday life and then in special areas of use for study purposes and even narrowly specified area of use for language purposes. Another area of interest was students´ engagement into enriching the content of the examined application via placing contributions which were made on the voluntary and mandatory basis. Last key explored area headed into future, into the seen potential for further university studies in the application.

The goal was reached; current SA landscape was described from both quantitative and qualitative perspectives. The analysis was done through the data processing where the cross tabulation was applied; comparison of the relationship between two variables could be done. Utilization of social applications and their potential was compared also via contingency tables. Key findings are summarised in the conclusion, this time in nominal numbers so that the readers could visualize the local scene. Only four respondents out of 67 don´t use Facebook daily for personal purposes. Out of 63 Facebook users only half of them use if for study purposes and only 21 use it for studying languages. 12 users enrich the content of the applications with contributions which are placed into the app on the basis of teacher´s instructions. Number of active voluntary contributors is higher, it reaches 32 students. 28 students out of 67 find potential and use Facebook. One can see potential but does not use this app. Other 35 respondents use Facebook but don´t see potential.

*Based on the findings gained from the contingency tables, all three of the hypotheses were accepted:*

- "When the student sees the potential in Facebook, he/she already uses it."
- "When the student can see potential in Facebook, they voluntarily insert their contributions."
- "When the student inserts contributions voluntarily, they will insert contributions on the basis of teacher's instructions ('compulsorily')."

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# User Evaluation of Geography Website

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**Abstract:** Another pursuit of scholars to motivate students and get them actively engaged into the learning in the environment of blended way of teaching/learning process is presented. The paper brings description of the process of website analysis from first impression through specialised tasks, evaluation based on the level of satisfaction to the final recommendations. The research area represents interdisciplinary field of developing geography knowledge and digital competences in university students via usability testing of geography websites by students themselves. Last year a research on incorporation of web-design user-testing method into the language learning process was run with students of Applied informatics and Information management study fields. Current research is a follow up stage comprising students of non-computer study field. Testing of websites offering games and quizzes on geography topics will be conducted with full-time and part-time students of Tourism management during their subject called Cultural studies on Africa and India in both environments virtual platform of learning management system and face-to-face classes. The goal of this paper is to describe a pilot phase of the whole assessment process of one of the selected websites called Shephard Software in detail. This pilot testing is supposed to reveal potential pitfalls which could be detected so that user testing of websites by students of Tourism management could be adapted accordingly to reflect needs and abilities of students with different computer competences, with different experience and behaviour. The sub-goal is to compare the outcomes and determine suitability of incorporation of websites into the process of education and define possible modifications in the content and structure of usability forms. The discussion raises questions relating to adaptation of user-testing forms, selection and a number of analysed websites.

**Keywords:** geography, usability testing, user satisfaction, didactics

## 1. Introduction

The problem, which is going to be solved in this paper, deals with a new didactic approach to exploration of websites. Each lesson both in face to face classes and individual chapters of e-coursesare usually accompanied with a list of recommended websites enriching the study content.There are many ways how students can utilize recommended websites by their teacher.Method based on usability testing of game-websites by university students of Tourism Management Bachelor study programme is discussed in the paper. Geography knowledge and digital competences are developed in university students via completing technical tasks and playing games with students whose major is Tourism management and not computers.

The contribution to academic debate is believed to be in the innovative didactic approach where students´ active engagement is encouraged via proven technical method evaluating design of websites. There has been nearly one decade long history in usability testing of language websites at the Faculty of Informatics and Management, University of Hradec Kralove. Last year a research on incorporation of web-design user-testing method into the language learning process was run with students of Applied informatics and Information management study fields. Current research is a follow up stage comprising students of non-computer study field. Testing of websites offering games and quizzes on geography topics will be conducted with full-time and part-time students of Tourism management during their subject called Cultural studies on Africa and India in both environments virtual platform of learning management system and face-to-face classes.

*The goal of this paper is to describe a pilot phase of the whole assessment process of one of the selected websites called Shephard Software in detail.* Shepard website analysis is run from first impression through specialised tasks and evaluation based on the level of satisfaction to the final recommendations with students of Tourism management.

*The pilot testing is supposed to reveal potential pitfalls which could be detected so that user testing of websites by students of Tourism management could be adapted accordingly to reflect needs and abilities of students with different computer competences, with different experience and behaviour*.

*The sub-goal is to compare the outcomes of part-time students and full-time students to determine suitability of incorporation website into the process of education and define possible modifications in the content and structure of usability forms.*

Following research questions were stated:

- Students of Tourism are not computer experts. Will this way of website analysis be difficult to manage or even bothering?
- Design of the analysed website seems childish even if it is designed for all age categories. Will university students be sceptical or positive to playing games? Will they refuse incorporation of this website into the subject syllabus?
- Will students appreciate the non-standard way of website exploration?
- Will adaptation of tasks in testing forms be needed?

The paper consists of following chapters: Methodological frame which covers literature background, brief outline of the project history on usability testing within English language classes at the Faculty of Informatics and Management, University of Hradec Králové, description of applied method and an accessible research sample. Following main chapters are Findings and Conclusion with practical implications.

## 2. Methodological frame

### 2.1 Literature background

Another pursuit of scholars to motivate students and get them actively engaged into the blended learning process is presented. Academicians pay an effort to provide students with various schemes and approaches to study materials (Čechová and Charbonneau-Gowdy, 2008). Potential of online games in the process of education is discussed at a wide scale of student´s development areas, e.g. problem solving activities (Hwang and Chen, 2012) or on-line games in individual educational subjects or disciplines (Godwin -Jones, 2014 or Van Eck, 2007), as for geography, see (Tüzün et al. 2009).

Usability testing of websites is presented in this paper also as a kind of game. It is a game comprising development of geography knowledge, language competences and computer literacy. First usability testing of English websites by English foreign language (EFL) students was run at our faculty eight years ago within a wide project on analysis of web language educational sites and their services with focus on navigation and ease of use (Černá and Poulová, 2009). Last year this proved method was applied with all sophomore students of Professional English language subject where aspect of game was highlighted (Černá and Svobodová, 2015). The objective was to select language web portals fitting needs defined by students of Information Management and Applied Informatics bachelor study programmes. According to need analysis revision of grammar and preparation for international language exams domineered followed by the need of providing explanation to gain results in tests. Practicing of website exploration via usability testing proved to be beneficial with students of computer studies (Černá and Svobodová, 2015).

*But what about students of other fields – will students of non-computer studies appreciate this way of exploring websites?*

Current research is a follow up stage. This year the specific user testing method has been implemented into the subject that ranks into the Tourism Management field of study which isn´t purely information one so that different perceptions and different approach from students might have been expected.The goal of the current research is to assess selected geography educational websites based on students’ need analysis according to time-proven Usability Testing with Five Users method (Nielsen, 2000 and Nielsen, 2012). Utilization of methodology based on user-testing of websites is becoming more widely applied in university setting, e.g. assessment of university library’s website (Duncan and Durrant, 2015). Potential of the interdisciplinary field of digital literacy and language competence in EFL learning context is discussed in (Debopriyo and Crabbe 2015). Authors claim that website analysis facilitates logical thinking and contributes to the development of functional language proficiency (Debopriyo and Crabbe, 2015).

### 2.2 State of arts

A list of appropriate web links is a standard part of study materials; teachers or tutors add them as main or additional sources mainly at the end of a lesson or study chapter in the e-course. Way of work with websites varies from mere mention in the e-course study content to their presentation during face-to-face classes. See illustrating extracts from the print screens taken from two e-courses: the Cultural studies (Geography chapter) and Professional English e-course (topic- Online dictionaries), see Fig 1 and 2.Students are getting acquainted with offered websites predominantly in a heuristic way. In our research students are provided with a sophisticated time-proved assessment method which can be perceived as a kind of guided exploration.

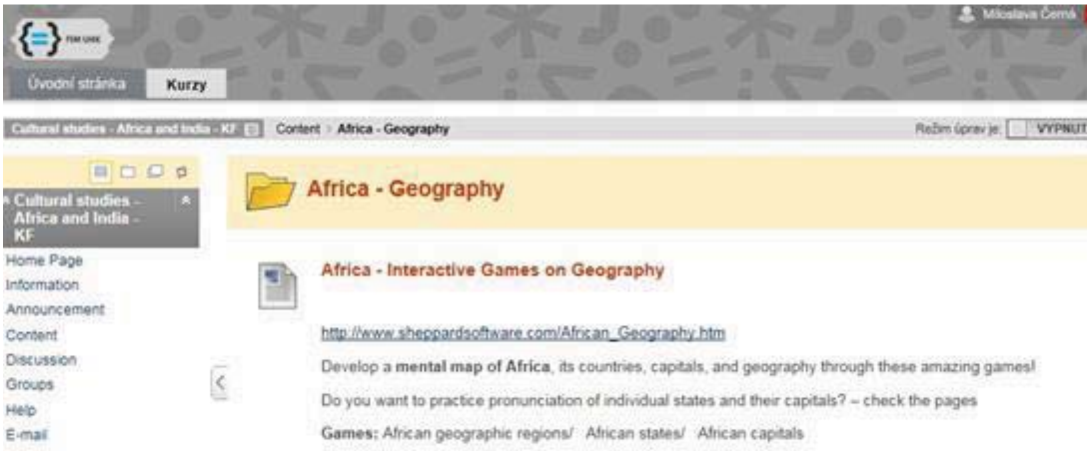


**Figure 1**: Link to Geography games in the e-course cultural studies – Africa and India


**Figure 2:** A part of the websites links to on-line dictionaries in the e-course Professional English

## 2.3 Research sample and research tool

Research sample consisted of full-time and part-time students of the Tourism management Bachelor study programme attending Cultural studies of Africa and India subject in summer semester 2016. The age span of part-time students was 22 to 38 years. As for full-time students they were 20 or 21 years old.

> *'Usability testing with Five users' is based on Five users who are able to detect more than 78% of information about usability of the design, more users generate small amount of new data (Nielsen, 2000).*

Research tool is a usability testing form consisting of 4 key parts which represent the 4 steps or stages in web-site analysis.

The first step focuses on*First impression of the website* - onthe General view of the server and its functions see Fig 3. Users who test selected website are asked to fill in a user-testing form with the link to the website which is going to be analysed. Firstly they just note down their first impression of the website. The authentic partof the completed formin red colour by a full-time student of Tourism management illustrates this step.

The second step called*First steps in the website* deals with completing general tasks in the website and completing special expert tasks in the websites, see Fig 4.The other part of the form brings two kinds of tasks which are supposed to be fulfilled: tasks which refer entirely to navigation through the website and expert tasks reflecting the field of study itself which is in this case Geography of Africa.Tasks with completed answers by a full-time student in Fig 4 illustrate this second stage.

Usability testing of language educational portals

Focused on Africa: **Do you know states in Africa?**

Sheppard Software
we make learning fun
http://www.sheppardsoftware.com/

**General view of the server and its functions**

- What is the main mission of the server? (Your first impression – max 1 minute)

*Play games and do knowledge tests. Visually feels more focused on children*

- What functionality or options does the server offer

*Play games and do tests*

**Figure 3:** First impression - Initial part of the user-testing form

| **Tasks** | *Time (min) search* | *Yes* | *No* | *Web address* | *Other information* |
|---|---|---|---|---|---|
| Are games free? | 1 min | X | | | |
| Does "Ad-free web site subscription" exist? | 5 min | | | *I don't know* | |
| Are there links to social nets? | 1 min | | | *Facebook* | |
| Is it possible to create own games? | 5 min | | X | *Maybe, after teacher's registration.* | |

| **Expert tasks** | *Time to find the page* | *Web address* | *Time to full fill the task* | |
|---|---|---|---|---|
| **Find section** "African Geography Games" | 20 sec | *http://www.sheppardsoftware.com/African_Geography.htm* | XXXXXXX | |
| **Find and Play the game "Drag the country"** from the section " All about Africa" – subsection "Countries" - **Level 2** | 10 sec | *http://www.sheppardsoftware.com/Africa/Africa_G1_1024_768.html* | **3 min** | |
| **Find and Play the game** "African river animals" | 30 sec | *https://www.sheppardsoftware.com/content/animals/quizzes/kidscorner/animal_africanRiver_btn_large.html* | **1 min** | |
| **Find contact** | 1 min | *https://www.sheppardsoftware.com/about.htm* | ***Brad Sheppard Jr. A Jasmine Chapgar*** | |

**Figure 4:** General and expert tasks in the user-testing form

The third phase is called*acquainted user.* After going through the websites, web-users are asked to describe the mission and functionalities of the website again. *They answer questions which were created to fit the objectives of the educational process, reflecting the subject topic and tutor´s needs and intentions or researcher´s interests*.

Questions in this phase are following:What is the mission of the website?For whom the games are designed?

Are there games also for adults or only for primary and secondary school children?Are the games categorized? If so, how are they divided?Will you play also some games which are designed for younger students? Or is it waste of time? What are positives and negatives of this website?

*Satisfaction*is the last fourth part of the assessment form*.* The last part of the usability testing form reflected students´ level of satisfaction in both quantitative and qualitative way. The scale spans from -5 to + 5.Users are asked to justify their choice, what real benefits they find in the website, e.g. study purposes or fun. Then they are asked whether it makes sense to incorporate games into university studies.

## 3. Findings

Sheppard Software website was tested by two thirds of students attending the Cultural studies of Africa and India subject as a free activity offered in the accompanying e-course. Students downloaded user-testing forms and proceeded on their own then submitted completed forms back into the virtual platform of Blackboard learning management system. Submitted forms were open to all students registered in the e-course.

During face-to-face classes two students from both full-time and part-time groups gave presentations on usability testing of Sheppard Software website then a follow up discussion on experience with this kind of website exploration was run.

*In accordance with principals of Usability testing with five users, paper findings from 5 part-time students and 5 full-time students are worked out in detail in this paper.*

As for findings relating to navigation and fulfilment of tasks there are no discrepancies between these two groups.

As for first website impression, '*fun, children, nice graphic design, quizzes and games'* are key words used by both groups.

To show the consensus between both groups one quote  from full time student and one quote from part time student follow: *'I think that main mission are quizzes, quizzes of all kinds and also games for children', 'to learn in a fun way via games, quizzes and other various activities'*.

*One problem was diagnosed* in the section of tasks. Users were asked whether there is option not to be disturbed by ads in the website – whether there is option of *'add free website subscription'*.  Only two part-time students managed the task, contrary two stated that they have no idea what the question means. As for full- time students, there was only one who did the task.

*So – how to respond to the problem?* The best way will be to exclude the task in spite of the fact that it was placed into the task list because users prefer the option to not be disturbed ads.

There were no troubles with finding link to social net-all respondents managed within several seconds.

Another problem appeared in the task where students were asked to find and play the game 'Drag the country'. All students from both groups found the game within few seconds, except one who searched for it for 2 minutes. *One full time student was not able to play the game*, the same student had also problem with another game – she found the game but somehow the game didn´t work.

*So – how to respond to the problem?* During the follow up discussion the game was checked and it worked. Anyway it is strongly recommended to check all the tasks in the user testing form whether they can be accomplished.

*The first discrepancy between two groups* was found: only two part time students wrote time of accomplishment the task which was 5 minutes and 4 minutes and 40 seconds – let´s say the same time and 2 part-time students wrote weird answer “54 questions”. Full-time students accomplished the task within 3 to 10 minutes except the one who wasn´t able to play the game because of technical obstacles.

*So – how to respond to weird answers?* Should teachers ask students to read questions properly to be able to correctly respond to the question? Will that be of any help? We don´t think so. *Questions must be relevant and clearly formulated.*

(Interesting note could be made in this place, students of Applied informatics programme completed also user testing forms of this website just because of interest during professional English subject, surprisingly all of them succeeded within six to ten minutes to find and do the test together with writing times and web address).

In the third part of usability website the testing user is supposed to be an acquainted user; he/she has become familiar with the website and is able to knowledgeably answer the questions.

Key words describing the mission of the website are similar in both groups: *'Fun, learning, learning by playing'*.

There is also consistency in the answers to the question 'Are there games also for adults or only for primary and secondary school children?' A few answers follow: 'Games are also for adults but games for children dominate, adults can play games form “Brain” section,''Games are mostly for children but nothing prevents adults to try to play'.

Researchers were interested in the responses to the following question. 'Will you play also some games which are designed for younger students? Or is it waste of time?' It might have been expected that students would not be willing to play children games, especially part-time students. All part-time and full-timestudentsresponded and their answers were visualised in the Table 1.

**Table 1:** Will you play also some games which are designed for younger students? Or is it waste of time?

| Part-time students | Full-time students |
|---|---|
| 1 If you have time it is not waste of time<br>2 For me it is waste of time<br>3 Yes I will.<br>4 Yes, I will, it is fun.<br>5 if a man has time, it can be used for checking knowledge ☺ | 1 I will use it even if they are for children; there is still information which is new to me.<br>2 It is fun<br>3 Probably not<br>4 Because there are various age categories I will select the one which is closer to me.<br>5 it is a fun form so why not to try it. |

Exploration of the web is run in a positive atmosphere. The following complex table – Table 2 brings all users´ notes on positives and negatives of the analysed website and partly explain their level of satisfaction.

**Table 2:** Table of positives and negatives

| **Perceived positives** | | **Perceived negatives** | |
|---|---|---|---|
| **Full-time** | **Part-time** | **Full-time** | **Part-time** |
| 1 Nothing | **1 Colourful and well-arranged** | 1 I miss option to communicate | 1 I found nothing negative |
| 2 Funny tests, search field a lot of tests | 2 Search field, division of geography games according to continents = fast and easy search; information is given to each country, good feedback function, instructions in many languages, | 2 Nothing | **2 pages are not well organized, A lot of ads disturbs me, pages are too colourful** |
| 3 Fast search of games, | 3 Nice pages, well organized | 3 Most games are for younger users | 3 Nothing |
| 4 Only positives. I like webdesign, nicely and well designed, easy navigation, I also | 4 Nice graphic design, Interesting games. Brain games. Fun.<br>This web is entertaining I enjoyed it. | 4 Nothing | 4 Nothing |

| Perceived positives | | Perceived negatives | |
|---|---|---|---|
| **Full-time** | **Part-time** | **Full-time** | **Part-time** |
| liked the chart 'popular Games' popular. | | | |
| 5 Fun form | 5 Nicely divided and nicely done for children, well arranged | 5 there is no direct language education | 5 Nothing |

Positive features dominate. Only one discrepancy has appeared. One feature can be perceived completely opposite, what is found by one man/ woman positive can be considered by other one negative, see the first and second part-time student in the Table 2.

*Level of Satisfaction with websites is very high*. Part time students assessed websites with highest awards: 5, 3, 3, 5, 5. Full-time students were little bit more sober in the scale evaluation: 5, 5, 1, 1, and 4.

It is interesting that assessment on the numerical scale is quite often different from the verbal ratings. Numerical rating is easier to visualize but is rather limiting, on the other site verbal rating might seem vague in some cases. That is why combination of qualitative and quantitative rating is desired.

Part-time students appreciate benefits of Sheppard Software website especially in education of children and possibility to test knowledge of their parent which was twice explicitly stated.

Nothing negative they find in the web-design which fits children education purposes more that university students purposes.

Connection of Fun and Education is valued by both part-time and full-time students.

When it comes to one of key questions whether it *is desirable to incorporate on-line games into university results are not conclusive*. Part-time students who were more enthusiastic in web-testing in two cases refused this idea and three accepted. Full-time students twice said 'I don´t know' and 3 times accepted this concept one of answers was positively explanatory: *'Definitely yes (incorporate this website and testing into the syllabus). Students can through quizzes and games learn for example location of states without spending hours staring into the Atlas, just click the mouse which is much faster'.*

## 4. Conclusion and implications

The research on user-testing of websites in university students strives for defining positives and potential negatives in incorporation of this didactic approach into the process of instruction when recommended websites form part of study materials.

Both sites students and teachers profiteer from utilization this didactic approach. Students learn the usability of web-sites testing method, learn language, improve computer competence, think about features which were of rather marginal importance to many of them like web design and structure of web-sites. They might even compile their own system of bookmarking.

Of course not only positives accompany this way of website exploration. Some students might find this way of website analysis time consuming. Teachers are given a motivation tool which might raise students´ interest learning recommended sources and allegedly higher chance that students will learn how to move in them, use them and eventually return to these websites.

The goal of this paper was to describe a pilot phase of the assessment process Shephard Software website.

All four phases of adapted usability testing were discussed and gained findings presented in graphs and tables.

Even if students of Tourism management are not computer experts, they can quite smoothly complete the tasks. This is the answer to the stated research question 1. The troubles which they faced during the evaluation process didn't discourage them even if they were not able to play the game due to technical obstacles. *They stayed very positive and enjoyed exploration of websites via usability testing method*. In comparison with students of Applied Informatics and Information Management they are more relaxed and not so punctual. They answered nearly all the questions in the form but didn´t waste time with detailed description of their progress in the whole process and filling in each cell of the usability testing form. *The less systematic effort they showed in the second phase the more verbal effort they used in the third and fourth phase when they commented on the familiarity with the website and satisfaction with it.*

The second research question dealt with the childish design of the analysed website. Both part-time and full-time were enthusiastic ready to play and ready to find positive aspect even in playing children quizzes and games. Connection of Fun and Education is valued by both part-time and full-time students as already emphasized in the previous section.

The third question aimed at fixed incorporation of usability testing into syllabus, positive responses prevail but it might be better to leave this issue on the *voluntary basis, give students chance to practise this way but not to push them, the charm of free choice might get lost*.

The last question dealt with the possible need of adaptations in the construction of usability forms. Definitely second part of the usability testing form will be adapted; a few technical tasks will be replaced tasks reflecting students' specialization. It is a must to run students´ need analysis like in the case of Professional English classes and prepare tasks accordingly. Pilot phase of the research has been successfully concluded. User testing analysis of geography and cultural heritage websites will be utilized in the following part of the research with students of Tourism Management.

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# Promoting Learner Awareness and Autonomy Using an Online Learning Platform for University Chinese

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**Abstract**: The paper will present how an Online Learning Platform for University Chinese I (CHLT1100) which was developed by the Independent Learning Centre and the Department of Chinese Language and Literature at The Chinese University of Hong Kong helps to promote learner awareness and autonomy in the learning process. The platform was first launched in 2014 and so far, a total of 2,556 students have used it. User feedback which was very positive was collected via a focus group study carried out from late 2014 to early 2015. Preliminary analysis suggests that the platform is able to: (1) heighten students' awareness towards the structure of their written language via the presentation of the characteristics of Chinese grammar through comparison; (2) enhance students' knowledge on Chinese grammar through the presentation of the detailed explanations on controversial terms and learning guides on various topics ; (3) encourage independent learning among themselves by engaging students to develop individual learning goals and reaching them through the pace they are comfortable with; and (4) stimulate students' interest in further studying the subject matter through the presentation of theories and the analysis of current language use and patterns. The paper will conclude by summarizing what makes online learning platforms like ours work and providing further improvement suggestions.

**Keywords**: independent learning, elearning, learner autonomy, Chinese grammar, Chinese language

## 1. Background

The "Online Learning Platform for University Chinese Grammar" was developed by the Independent Learning Centre (ILC) in collaboration with the Department of Chinese Language and Literature (CLL) of the Chinese University of Hong Kong (CUHK). The platform in fact is the result of a project titled "Online Learning Platform for University Chinese Grammar in Use" which was funded by the Teaching Development Grant (TDG) of the university. The Platform is the first of its own kind. And the collaboration is unprecedented in our context as it is the first tailor-made online learning platform specifically developed to support a credit-bearing mandatory course for the vast majority of our undergraduates by two different academic units. One of the major goals of the language policy in Hong Kong is to develop "bi-literate and trilingual" abilities among students. And by that, it means students are expected to be fluent in both written & spoken English, written Chinese, as well as Putonghua and Cantonese (spoken variety). In the CUHK, students whose native language is Chinese are expected to have attained a relatively high level of proficiency in both Chinese and English upon graduation, and be able to use both languages effectively in daily life (The Report of the Committee on Bilingualism, 2007). At present, two 3-credit courses, "University Chinese I" and "University Chinese II", are offered to the first year and second year students respectively. Overall, they aim to "consolidate and reinforce students' command of the language, inculcate critical thinking that crosses temporal and cultural boundaries, and enhance students' ability to communicate in an effective and articulated manner" (Reports on Language Enhancement Programmes 2012-13, P11). And Chinese grammar is a core component to the successful completion of the two Chinese courses. However, Chinese is difficult even for many native speakers as it is a language with isolating morphology. And many language experts believe that learning Chinese is "more than just being able to speak the language fluently; learners should *master the grammar system* and understand how modern Chinese develops in recent years" (trans. Shao, J. M. et al, 2001; emphasis added). In order to help our students develop knowledge in the language and eventually master the Chinese grammar, on top of helping them develop a habit of learning independently, an online learning platform was developed to support the learning of University Chinese I (CHLT1100).

## 2. Content and learning tools of the online learning platform

Taking into account the course curriculum of University Chinese I (CHLT1100), as well as students' different levels of prior knowledge in the language and their individual learning preferences, the Online Learning Platform aimed to supplement face-to-face classroom teaching and support students' independent learning of Chinese Grammar by offering detailed explanation of technical grammar terms through interactive exercises via a user-friendly interface. There are eight chapters on the platform and they are - Chapter 1: Foundation of Chinese Grammar; Chapter 2: Distinctive Features of the Chinese Language; Chapter 3: Formation of Words and their Lexical Classification; Chapter 4: Analysis of Sentences; Chapter 5: Practical Use of Chinese Grammar in Hong

Kong; Chapter 6: Application of Grammatical and Lexical Knowledge in Writing; Chapter 7: Hierarchy of Grammar; Chapter 8: Learning the Rhetoric through Blogs, Buzzwords and Literature (see figure 1). While the first three chapters (1 to 3) serve as foundation chapters providing learners with the grammar basis at the word level, the next two chapters (4 and 5) allow learners to understand the Chinese grammar at the sentence level using authentic examples. The final chapters (6 to 8) invite learners to see the connections between the theoretical grammar knowledge and the application aspects of the language in everyday texts. Useful learning tools such as the note-taking function, pop-up explanations and progress checks are there on the platform to assist students in taking control of their own learning. The note-taking function allows students to copy examples directly from the platform before adding their own personal notes for revision purpose later. Pop-up explanations, on the other hand, provide extra information and short definitions for technical Chinese grammar terms as students study through the chapters. Recommendations for further readings are also provided for those students who want to explore the concepts further independently. While their class teachers would share their expectations with the students, students are generally left alone to set their own learning objectives and study at their own pace on self-selected topics. Furthermore, the platform aims to stimulate students' interest in studying the Chinese grammar in depth. It is hoped that students eventually become better writers through learning how to appreciate the Chinese language. Progress of the users can be tracked via progress checks and teacher can easily see students' individual performance and recommend additional quizzes when necessary.


**Figure 1:** Screen capture of the contents page of the online learning platform

## 3. Launching of online learning platform and evaluation of platform

The Online Learning Platform was first introduced in the fall semester of 2014. Before its official launch, an orientation about the objectives, design, functions, and suggested learning activities was given to all course teachers of University Chinese I (CHLT1100) in the summer. Teachers were asked to encourage their students to use the platform as an independent learning tool to support their learning of the subject. A total of 414 students registered as users during the semester.

In order to better understand how students use the platform and their perception of the learning effectiveness, a focus group study was conducted from late 2014 to early 2015. Ninety-one invitation letters were sent to the Business and Engineering students taught by Dr Lai Bit Shun. Twenty-four students in the end agreed to take part in the focus group discussions facilitated by Dr Benson Lee and Ms June Wong of the ILC. All discussions were recorded and then transcribed for thematic analysis by Mr. Cai Shao Feng and Mr. Ruan Wen lve. While students were invited to also comment on the blended learning arrangement of University Chinese I (CHLT1100), they were specifically asked about the content and their use of and experience with the Online Learning Platform:

- How did you understand Chinese Grammar before using the Platform and has your understanding of Chinese Grammar changed in any way after using the Platform?
- On a scale of 1 to 10, how would you rate the explanation of the technical terms on the Platform?
- How do you find the design and user-friendliness of the Platform?
- Do you think the Platform is conducive to independent learning among students?
- Do you like learning Chinese Grammar via the Online Learning Platform independently? Can you cite your experience in using the Platform?

## 4. Findings from focus group discussions

In general, the comments collected from the focus group informants were very positive. Four most commonly mentioned themes are presented below.

### 4.1 Heightened awareness towards the structure of Chinese language via comparison approach

One of the most commonly cited advantage of learning Chinese Grammar via the Online Learning Platform by the focus group informants is that their awareness of the patterns and structures of written Chinese has been heightened via the clear and contrastive comparison of the Chinese and English grammar.

Because of the language curricula in Hong Kong, most local students do not pay much attention to the study of Chinese grammar. As mentioned by one of the informants, “We started learning the basis of both Chinese and English languages since primary and we began learning about different writing styles at the secondary level. However, the emphasis then was on learning the English grammar. We did very little on the Chinese grammar. One of the advantages of the platform is that we can learn the Chinese grammar through the detailed explanation of the subject matter (Student A, Focus Group 4).”

The high status of English in the local society due to historical reason as Hong Kong was a British colony before 1997 has huge impact on the allocation of teaching resources and class time in local schools. As a result, English grammar is emphasized and many students learn written Chinese under the influence of the English grammar, and hence the “Europeanized Chinese Language” phenomenon is very common among students. As mentioned by another informant, “We have been reading a lot of Europeanized Chinese works since secondary. We have been under the impression that Chinese and English grammar are very similar, or even interchangeable; and it’s not uncommon for us to use Europeanized Chinese even in formal situations. But after taking University Chinese I and using the Online Platform, I now see the difference between the Chinese and English grammar. There are many unique elements in Chinese and such cannot be found in English (Student B, Focus Group 4).”

With reference to “Medium of Instruction Guidance for Secondary Schools” and “Fine-tuning of Medium of Instruction for Secondary Schools”, all secondary schools in Hong Kong are divided into English-medium schools (EMI) and Chinese-medium schools (CMI) respectively. Although Hong Kong ceased to be a British colony on 1st July, 1997 when it was handed over back to Mainland China and that both English and Chinese were made the official languages in Hong Kong then, English continued to enjoy a special privileged status among many Hong

Kong people. EMI is still the preferred choice for many parents (Vincent and Adamson, 2010). And in order to meet the parents' expectations, many schools devote resources and time in developing their students' English language proficiency. While English grammar is taught comprehensively and systemically from primary through secondary, Chinese grammar is usually barely touched. And probably due to this reason, regardless the medium of instruction of the schools, students seem to associate the study of grammar with English only. In fact, only selected concepts of Chinese grammar are introduced at the secondary level, and most are introduced only because they are considered as an aid to enhance students' reading and writing abilities. For example, parts of speech and category of sentences are only taught because they are considered to be helpful in reading comprehension and literature appreciation.

Against the background mentioned above, the contrastive comparison approach is considered to be helpful in heightening students' awareness in the Chinese grammar. Chapter 2 of the Online Learning Platform, therefore, focuses on introducing the characteristics of the Modern Chinese language through comparison. There are 4 parts and Part 2 is the comparison between English and Chinese (see figure 2). The isolating characteristics of the first language (Chinese) were compared with the inflectional morphology of the second language (English) and hence making the former very easy to understand. The content of Part 2 encourages students to apply their understanding of the English grammar to review and reflect on the structure of Chinese.


**Figure 2**: First page of the part 2 (Comparison between English and Chinese), Chapter 2

Standardization of written Chinese has always been a problem for Hong Kong students. Therefore, the differences in the grammar of the two languages are highlighted and explained using everyday examples on the Platform for students' quick and easy understanding. Part 3 of Chapter 2 is the comparison between Putonghua and Cantonese and Part 4 is the comparison between Classical Chinese and Modern Chinese. Putonghua is the official language in Mainland China and it corresponds to written Chinese; Cantonese is the oral Chinese spoken by over 97% of the Hong Kong population. Not only do the two differ hugely in the sound and vocabulary systems, their grammar structures are very different also. Seeing that most Hong Kong students grow up speaking Cantonese, learning written Chinese, and spoken and written English through the local education system, it is believed that the comparison approach should work for them. And comments collected from the informants of the focus group discussions confirm the effectiveness of such an approach.

## 4.2 Enhanced knowledge on Chinese grammar through studying detailed explanations on controversial terms and learning guides

Content of the materials on the Online Learning Platform is another area that was highly appreciated by the informants (see figure 3). As mentioned by two of them, "For a beginner like me, I would give the Online Platform 7 (out of 10 points). I think the explanation of the technical terms is very comprehensive and the unique features of the language are illustrated in a very clear and easy-to-understand way (Student A, Focus Group 4)." They continued, "The content is very clearly presented. Take the complex sentence as an example. The chapter begins with clear explanation of concepts, followed by examples and illustrations. All these are critical for our understanding. Besides, there are practices at the end of the chapter to make sure we understand the concepts correctly. Overall, I think the way information is presented is very nice. In terms of clarity in presentation, I would give the Online Platform 8 (out of 10) (Student E, Focus Group 1)." It is in fact not difficult to understand where the users of the Online Learning Platform are coming from. The first Chinese grammar book: Mashi Wetong was published in 1898. The author used the grammar of Latin to analyze wenyan (the written form of Classical Chinese). And after the May Fourth Movement, written Chinese had moved from wenyan to baihua (standard form of Modern Chinese), as the latter was heavily promoted by the then Chinese government. As a result, grammar books for baihua flooded the market. Lacking a standard way of presentation, the grammar of baihua was usually explained through other language systems. In sum, there are very few, if any, user-friendly Chinese grammar books in the market.

Our solution to the above is to create an Online Learning Platform with materials based on textbooks of solid research efforts (e.g. Li & Thompson (1989) Mandarin Chinese — A Functional Reference Grammar, Shao,J.M. et al. (2009) Hanyu Yufu Zhuanti Yanjiu and Li, Liang et al. (2013) Studies On Contemporary Chinese Grammar) and good reputation to support students' learning. Our goal is to present our students with the Chinese grammar basis and detailed explanations on controversial and difficult technical terms in the field. To facilitate students' independent learning of the subject matter, self-explanatory learning guides are provided. We find the blended learning arrangement where students first receive face-to-face sessions before extending their learning of the Chinese grammar independently after class via the Online Learning Platform suits our purpose very well. And as argued by Thomas et al (2015), one of the major benefits of self-directed learning is "extending subject knowledge, by covering more material than could be covered in face-to-face sessions only, moving beyond the basic/ minimum level of understanding towards deeper learning, and understanding theory by relating it to practice". The Platform first provides users with the fundamentals of the Chinese grammar, followed by authentic examples and detailed explanations. Further, the learning guides which include reflective questions, self-assessment questions, and recommended readings provide users with further extended opportunities to test their knowledge after studying the subject matter on their own.

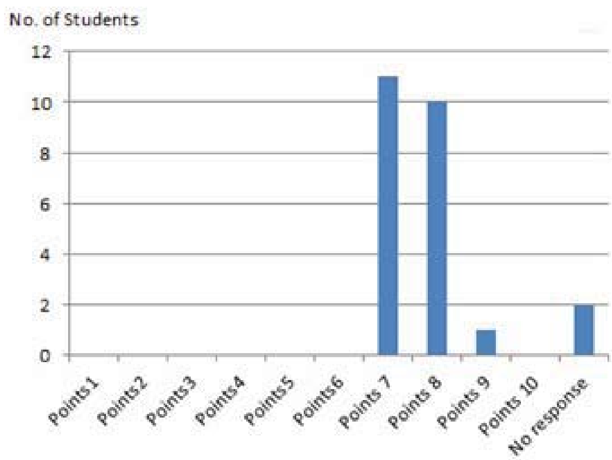


**Figure 3**: On a scale of 1 to 10 (10: Extremely clear and comprehensive; 1: Extremely unclear and not comprehensive at all), how would you rate the clarity of explanation of the technical terms?

### 4.3 Promotion of independent learning habit through engagement users with content and goal setting

Many informants from the focus group discussions confirmed that they were motivated to conduct independent learning of Chinese grammar because of the interface of the platform: "I like the interface; and also the fact that I could set my learning goals and learn the content at a pace which I am comfortable with (Student G, Focus Group 4). "

Another informant added: "I would like to comment on the coverage and depth of the Online Platform. Apart from studying the chapter on compound sentence intensively, I have in fact read through other chapters. I like the fact that this Online Platform allows us to see the range of issues related to the Chinese Grammar. It's also good that we can see the application of the grammar in authentic situations. Furthermore, I like the fact that I can access the Platform any time I like. Take myself for example, I like studying the chapters while I'm having my dinner (Student C, Focus Group 1). "

> *"I don't think how to use the Online Platform needs to come from teachers. In fact, the teachers can give us a suggested timeframe for the completion of significant readings, let us know how the Online Platform can be used to improve our learning, and then just allow students to freely use the resources on the Online Platform as and when they want (Student C, Focus Group 1). "*

> *"I think still there should be some mark incentive to encourage students to use the Online Platform. If the Platform has got absolutely nothing to do with the course grades, it would be hard to motivate us. In fact, the current arrangement is fairly nice as the pressure on using the Online Platform is not too heavy (Student D, Focus Group 2). "*

Overall, among the 24 informants, 16 of them agreed that the Platform was conducive or very conducive to independent learning.

Contrary to most people's common belief, students, when conducting independent learning on their own, are not looking for some very fancy design or overly complicated functions on the web. What most students need is only a user-friendly platform that allows them to navigate easily and locate specific information anytime and anywhere to fulfill their learning purposes. The straight-forward and optimal design of the Online Learning Platform seems to be able to deliver what most students look for – content is divided into meaningful chapters and layered in such a way that fulfills different students' different learning purposes set by them. And only the learning tools, such as the note taking tool, which are conducive to the independent learning of the subject matter are included. We feel that this Online Learning Platform is much appreciated by users as it gives them the much needed flexibility to learn the subject matter the way they are most comfortable with, and yet without over-burdening them with excessive and unnecessary information.

### 4.4 Increased interest among students in studying the Chinese language on own motivation

Using authentic examples in daily life situations to explain difficult concepts and technical terms related to the Chinese Grammar, the Online Learning Platform seems to be able to increase users' interests in further exploring the subject matter on their own. As mentioned by one of the informants: "Since more emphasis was put on the public exam results, we were not taught how to write good Chinese (at the secondary level). We were not clear about the technical terms related to the Chinese Grammar. After using the Online Platform, I understand the basis of the Chinese Grammar. With the examples on the Platform, I can now understand how the language is used in authentic situations. I can also appreciate certain skills in Chinese writing (Student F, Focus Group 1)." One of the yardsticks to measure success of any online learning platforms should naturally be its ability in motivating users to become more interested in the subject matter and hence study the subject matter further on their own. As Thomas et al (2015) pointed out, students expect higher education should be "providing interesting and relevant DIL (Directed Independent Learning) opportunities that contribute to degree outcome."

## 5. Conclusions

The Online Learning Platform has received fairly positive feedback from the focus group informants mainly because of (1) the adoption of the contrastive comparison approach where Chinese grammar is introduced capitalizing on the English grammar that students already have through their secondary education; (2) the clear presentation and detailed explanation of controversial and technical terms in the Chinese grammar using authentic and daily life examples; and (3) the user-friendly web interface which includes layered information, optimal learning tools and goal setting strategies to motivate students to conduct independent learning of the subject matter anywhere, any time and at a pace they are most comfortable with.

Based on the users' feedback, the ILC will further improve the existing Online Chinese Grammar Platform by (1) including more examples to illustrate how Chinese and Chinese grammar is used, and (2) including videos or animations to further stimulate students' interest in learning the subject matter. The ILC also has plans to collect user feedback from the course teachers and see how the Online Learning Platform can further assist them in delivering "University Chinese I" or even "University Chinese II" in future.

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# Moving Away From Comfort Zones: Working in Community With Teacher Educators to Promote e-Learning Classroom-Based Research

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**Abstract:** Teacher educators are considered by many as a source of hope and leaders of change in education, especially in challenging times and contexts. It is little wonder given the responsibility they have to form future teachers of potentially, generations of young people over the next half-century. Being a model, guide and promoter of effective teaching practices increasingly involves e-learning-based tools. With the advent of e-learning has come tremendous pressure on teacher educators to change their established ways by adopting ICT tools in their daily practices. Research in the last decade has indicated the enormity of the challenge to change teachers' practices with regard to ICTs. In our experience, promoting the integration and choice of effective e-learning practices among teacher educators, has been an even greater one. To reverse this trajectory, we have sought to establish an alternative scenario. In this paper, we report on a 5-month Action Research Study conducted with teacher educators in the context of an English Pedagogy Program in Chile. Self-selected teacher educators were encouraged, guided and supported in a virtual community space to conduct their own classroom-based research involving social media tools, in order to address the challenges they were facing in their teaching. The study is framed by our beliefs in sociocultural theory, the power of community meaning-making along with reflective practice to lead to social transformation and learning. This Action Research builds on and was inspired by our earlier study in this context that led to an adapted TPACK model which underlined the connection between teacher educators e-practices and sustained changes to those of pre-service teachers. Using a variety of ethnographic tools at the level of the Action Research and the classroom-based studies, we describe how this project led to new understandings in the use of e-tools in Teacher Education and the influence they had on learning and practice on several levels.

**Keywords:** teacher education, communities of practice, TPACK, critical thinking, self-directed e-learning

## 1. Introduction

In many parts of the world, teachers are acclaimed and respected for the value they offer to building cultures and nations through educating future citizens. Indeed, it is in those countries where teachers are most valued that the quality of teachers is seen as a predictor of its economic success, the level of its productivity, its democratic principles, and the health and happiness of its people (Sahlberg, 2011). As the renowned US educator, Freeman Habrowski (2016), expresses: "We the teachers make the difference."

In countries where teachers have not this same status, the picture looks quite different. Without the respect of governments, policy makers, fellow citizens, parents, or even each other, teachers in these countries often lack the courage and strength to practice their profession with determination and an eye to the future. Instead, they remain in their comfort zones, guarding their established ways and conceptions of what learning *has been* rather than looking ahead at what learning *should and could be*.

Increasingly, the use of technology, especially social media, both in our personal lives and in learning sites is influencing how learning should and could be. Having teachers everywhere recognize and take account, indeed exploit this influence in pedagogically and theoretically sound ICT-based practice, has been the topic of much discussion and the focus of a plethora of multidisciplinary studies for the past 15 years in educational research. Our own work in this area has led us to recognize Teacher Education as the ideal place to have the most impact in this pursuit. Yet, if the Teacher Education practice exists in a setting where teaching is considered a low-status service, we have asked ourselves how and what course of action should be taken to support a transition to the use of ICT? How can we promote empowerment and change in these settings, where change means opening up to sound e-learning practices? This study is an attempt to respond to that preoccupation. Through it, we aimed to undertake a further step in our earlier work (Charbonneau-Gowdy, 2015) that indicated that adopting models that support a complimentary combination of pedagogical, content and technological knowledge in Teacher Education (Misha & Koehler, 2006) for promoting technology uptake by pre-service teachers, was promising *in theory*. Yet, it was clearly evident that *in practice* sustained uptake would require the involvement of the whole community of teacher educators rather than a few mavericks. The questions that evolved in considering these findings became: How could we influence a community of teacher educators to join the ranks of the mavericks in adopting technological practices in their teaching of pre-service teachers? What would be the results of this influence on the teacher educators and their practices, if any? How would their teacher educator practices, be reflected, if at all, in their students, i.e. future teachers, and their emerging teaching practices?

The aim of the inquiry while responding to these questions was to determine how to promote an effective use of ICT among teacher educators that would stimulate concrete action and that would have sustained value in the local community of teacher education as well as at the level of pre-teacher training. In the next sections, we describe the theoretical underpinnings and literature that supported the inquiry and provide an analysis of the two research projects that resulted and which we consider successful in responding to these aims. The key findings that emerged are explained and practical suggestions for engaging teacher educators with research in technology are provided. This evidence is linked to the theoretical premise that there exists a relationship between teacher research engagement and quality teaching, which as stated above, implies an active use of effective social-learning technologies. Another driver of this initiative was the potential emancipatory value of reflective teacher-driven classroom research, which had a special appeal in the context where the study took place.

## 2. Literature review

Our study is based on Sociocultural learning theories that define learning, i.e. change, as a social, dynamic, dialogic activity that takes place in physical and social contexts and is dependent on the persons, the tools and the activities that make up these environments (Vygotsky, 1978, Wertsch, 1991, Bakhtin, 1981). Further, such sociocultural theories support classroom practices where active engagement, learner agency, collaboration, self-directedness, teachers as facilitators, and investment in learning are promoted and seen as crucial for learners to develop the skills needed for modern society's demands (Norton, 2011). One important tool of course, integral to this society, is using ICT for effective learning. Indeed, as we have alluded to above, the use of ICTs in formal learning sites is increasingly being connected to quality learning and teaching.

While accepting the value of viewing learning from a sociocultural perspective, we recognize that this perspective involves a turn away from an acquisition-based learning model towards a practice-based one (Zeichner, 2015). The latter emphasizes participation, engagement and reflection (Grossman & McDonald, 2008) while the former on information transfer and emphasis on content knowledge. This shift to a dynamic, practice-based process of learning has been supported by over 20 years of research based on Lave and Wenger's (1991; see also Lave 1996) theory of Communities of Practice. Their classic study is particularly useful in framing our inquiry because they help explain how we might approach change, in this case the use of ICT and social learning technologies, among a group of teacher educators. According to this theory, learning and teaching occurs within communities through a process of apprenticeship in practice and where there is increasing levels and various forms of participation. In this study and in the context of our Teacher Education community, we looked for spaces for the lead author, herself a an experienced researcher in the use of social learning based technologies and teacher educator, to work with other teacher educators, well experienced in preparing EFL teachers but with limited exposure to the advantages of reflective practice and e-learning. In such spaces, we initiated a reflective dialogue among the participant teacher educators as a means to finding solutions to their teaching challenges using social media tools at the classroom level. Using this dialogic-based approach to promoting change, we saw hope and potential for development not only in the teacher educators themselves but also in the influence they would have on pre-service teachers' use of ICT in their own emerging classroom teaching practices.

Along with an emphasis on meaning-making within communities as a source of learning, sociocultural theory has led to the spotlight in research being directed at the classroom and what happens there. The proliferation of studies in education in the last 10 years that have connected reflective practice on the part of teachers to the potential for valuable knowledge at the classroom level, where it matters, is noteworthy (Borg & Sanchez. 2015, Farrel, 2015; Hammersley, 2007, Hampel et al. 2015), although not without controversy (Brown, 2005). It has long been established that teachers' conceptions of their work are a powerful influence on their actions (Borg, 2013). If at the same time, we accept that teachers' conceptions are formed through reflections that come through classroom-based research, then it follows that if we are seeking to promote the use of ICT in teacher education settings, there is an opening to do so within reflective-practice research.

Despite the fact that the advantages of classroom-based research to teaching and teachers are well documented and empirically supported, the instances of teacher/educator classroom-based research when the focus is researching in online classroom spaces, remains limited (Borg & Sanchez, 2015, Charbonneau-Gowdy, 2015a). Exceptions (Hampel & Stickler, 2015), similar to our own early inquiries (Charbonneau-Gowdy, 2015), establish that successful uptake of e-learning practices at whatever level requires the development of new teaching skills and that this development will best be accomplished through reflective practice and community support. Hampel and Stickler, for example, cite a recent survey of teachers conducted in Europe that indicated that despite recognizing the advantages of ICT in their teaching, less than half of the teachers researched reported having had any formal training and or support to assume regular use in their classrooms. Our experience and study of the Chilean context has shown that modeling by teacher educators is a critical component of the combined TPACK model of technological, pedagogical and content knowledge required for ensuring sustained ICT uptake in pre-service teachers. It follows then that teacher educators themselves must have such guided occasions for developing the practice of using ICT too in order to be in the position to effectively model and inspire the practices of their students, our future educational practitioners.

In the next section, we describe the design of our inquiry that sought to transform the teaching practices of a small group of teacher educators through Action Research (AR) with the support of social-networking technologies and the two successful classroom-based studies that resulted. Thus the study took place on two levels. The first level involved the lead author who guided the reflected classroom-based mini studies of the Teacher Educators use of e-learning solutions to the problems they were facing and to document the changes. The second level was to examine the changes that occurred as a result of this initiative on the Teacher Educators and on the pre-service teachers they taught at the time. The ultimate goal of this dual-level inquiry, was to inform teacher education practices, using evidence and data-based processes, about the value of e-learning as a means to improving our teacher education programs and potentially the emerging practices of new teachers in the Chilean system.

## 3. Methodology

We chose to conduct the research within the qualitative research paradigm, using an AR methodology as a framework for the study. The nature of this paradigm and an AR methodology supported our focus on collaborating as a group of teacher educators in reflecting critically on classroom practices and following through with efforts to seek ways on how we could best respond to issues, with support from social network-based technologies. The ethnographic tools available to us within this paradigm also enabled us to adopt both an emic and ethic perspective, i.e. as participant and observer. This insider/outsider position we believe helps to add a further level of reliability to the findings we report on (Stowell, 2013) in this paper.

*Context*

The study took place among a group of English as a foreign language (EFL) teacher educators, who work in two disparately located campuses of a private university in Chile. Chile suffers from a deep and complex array of issues in terms of its education system. Economically, it is the most stable country in South America and is a proud member of the OECD. The latter factor has helped in defining some of the areas of the system most in need of attention. Teacher education is one of these areas; raising the level of EFL communication skills within the population is another; promoting the use of new technologies to promote 21st century learning is a third. In response to OECD studies and reports on education, in 2012, the Ministry of Education created incentives to various Chilean universities in an effort to upgrade the teacher education programs, including the English Pedagogy Programs, in the country, with a view to improving international standardized test scores by raising the quality of teachers who graduate. At this point, the integration of technology into these teacher education programs, considered elsewhere as an indicator of quality and effective teacher education, seems ad hoc and remains at the discourse rather than applied level. We see as a consequence of this situation that e-learning practices in schools are generally not apparent. The inference in the government incentives is that graduating teachers have been poorly trained and at the same time are not showing evidence of offering the level of quality teaching that is desired. In both instances, teacher educators are ultimately held responsible.

*Participants*

The teacher educators, Marta and Tomas (pseudonyms), whose classroom-based research we report on in this paper are Chileans, are both experienced teacher educators, eight years and nineteen respectively, a female and male both in their fifties. Both have extensive prior experience teaching in schools. Marta is a full time professor at the university and works in Applied Linguistics and EFL teacher training. At the time of the study, after twenty years teaching, she was in the final stages of her doctoral studies and thus an emerging researcher. Tomas, a full-time professor in the Teacher Education Program completed a Masters' degree in 2012 and since then has engaged in no formal research practice.

*Design of the Study*

The study was conducted on two levels (see Figure 1). On the first level, the lead author collaborated with colleagues, themselves experienced teacher educators, although not classroom researchers, in order to promote, initiate and facilitate classroom-based research in their individual classroom teaching contexts. An initial face-to-face meeting was held at the beginning of the semester to open up a dialogue around classroom-based e-learning research and in order to initiate reflections on topics of concern in the teachers' individual teaching education practices. Social-learning technologies, i.e a community blog, video-conferencing meetings and a wiki, were then used during the 4-month semester to support the ongoing collaboration at this level. The blog was conceived as a site for constructive meaning-making and support for each of the educators as they developed and conducted their research projects. In the nature of AR, the research initiative became an ongoing collaborative process supported by the selective social-networking technologies. Data was collected among the teacher educators/research cohort using a variety of ethnographic tools: 1) field notes, for example from virtual collaborative meetings; 2) document analysis, i.e. e-mail messages and queries sent to the lead researcher, plus postings on the community site and in the wiki; 3) reflective journals from the educators who persevered in the research initiative.

<u>Teacher Educators + Researcher/Teacher Educator</u>
Aim: *Promoting classroom-based research*
Supporting E-tools: *Community blog, wiki, videoconferencing*
Data Collection Tools: *Field notes, document analysis, reflective journals, focus group meetings*

<u>Marta's Classroom-based Study</u>
Aim: *Empowering student teachers to take control of their learning*
Supporting e-tools: *Community blog (Edublogs), Youtube, Social media*
Data Collection Tools: *Observations, Individual and Focus Group Interviews, Document Analysis, Field Notes*

<u>Tomas' Classroom-based Study</u>
Aim: *Developing more critical awareness in student teachers' perceptions and communications*
Supporting e-tools: *Community blog (Edublogs)*
Data Collection Tools: *Observations, Individual and Focus Group Interviews, Document Analysis, Field Notes*

**Figure 1**: Design framework of the concurrent research studies

On the second level of the study (see Figure 1), the same teacher educators conducted their own AR inquiries in their classrooms with their prospective teacher students. Each of the teacher educators were encouraged to work with their students to make changes to a pedagogical issue that they deemed was hampering progress in learning among their teachers-in-training. The teacher educators were also encouraged to collect data over the period of the semester again using ethnographic tools: 1) observations from classroom interactions; 2) recorded individual and focus group interviews with their pre-service student teachers; 3) document analysis of the various assignments generated by the student teachers; 4) field notes, such as test scores and informal conversations with students and other faculty. Again at this level, the teacher educators chose to use social networking tools to support the steps they took to address the issues they faced in their day-to-day teaching practices with the pre-service teachers.

Ethical considerations that were taken involved having teacher educators and pre-service teachers in their classrooms sign ethical consent forms. Pseudonyms were used to protect the identification of participants.

*Data Analysis Process*

Data sets generated both from the teacher educator/researcher study and the concurrent classroom-based study with the pre-service teachers were analyzed on an ongoing basis using standard qualitative methods for uncovering salient themes and patterns. In the next section, after a short introduction, we begin by reporting on the 2 classroom-based studies that we deemed successful, followed by the analysis and findings generated at the level of the researcher/teacher educator collaboration.

## 4. Findings and analysis

When the idea of conducting classroom-based e-learning research was first introduced to the small group of teacher education faculty by the lead researcher, the suggestion was met with understandably guarded interest. The individuals present, although mindful that research is increasingly being encouraged at the university, are also aware of the barriers that stand in the way of any obvious movement in this regard: limited resources, both financial and time due to little access to grants and demanding teaching schedules, unlike any in more developed countries; lack of skills and knowledge since most have undergraduate or masters' degrees and thus limited experience in conducting research of any kind; leadership attributes, i.e. lack of support from immediate managers; political issues, in other words a country that values large government quantitative research in education and where teacher educators' voices have little impact. In terms of blocking incentives that employees may have to conduct research, Borg (2010) cites non-collaborative culture and leadership attributes as the most high-risk. Indeed, the data clearly indicated the high-risk nature of this setting in view of the changes that were being suggested. In the next section, in the limited space available in this article, we describe the two successful studies that resulted at the classroom level despite the challenges and their salient findings. A report of the findings from the overarching research initiative between the teacher educators and the lead author research is explained in the last part of the section.

*Marta's Classroom Research Study*

Marta's study consisted of leveraging social–networking technology as well as social media sites to support a challenge to her students. Her aim was to have these future teachers assume responsibility for and address the language skills that individually posed each of them the most difficulty. In other words, through her reflective practice and research Marta sought to find ways to empower these future teachers to use ICT to support self-directed practices beyond the classroom. This was no easy task, given the lack of preparedness these individuals had from their previous schooling to assume responsibility for their learning with or without the use of technology. She based her classroom study on scholarship that strongly suggests that her own practices would have a positive modeling affect on these individuals in their future teaching (Borg, 2010: Lathan & Carr, 2015). Standardized test results and the realization that the pre-service teachers came to about their language challenges was the springboard for action to make changes. Each of the student teachers was given a chart on the community blog where they could record the time devoted daily to working in social media on their particular "difficult" skills. As well, the blog served to support a degree of relationship building between Marta and her students that would have been impossible in the classroom.

The significant data that Marta collected from the various data sets suggested that the combination of a) the evolving student/teacher relationships b) the opportunities for co-constructing and negotiating meaning in the virtual classroom and c) the authentic nature of the materials found online, made possible due to the affordances of the various social media and networking sites, were instrumental for the majority of encouraging results that were generated.

The results clearly indicated that the use of ICT to support the self-directed initiatives of the prospective teachers was successful. The data that emerged not only showed evidence of linguistic change, i.e. learning, but also a change in the identities these students constructed as learners and future teachers. The data also indicated an awareness on the part of the pre-service teachers of how these gains were made possible through the selective use of social networking technology. Table 1 summarizes the main results and provides representative examples from the data on which we based these findings.

**Table 1**: Summary of findings – Marta Study

| Finding | Representative quote from the data sets |
|---|---|
| greater metacognitive awareness | "*Now I'm focused on changing the methods that I use to learn English. Maybe I need another kind of methods to learn faster and easier this language*." E-portfolio Self-assessment, Student 4, December 2015 |
| active engagement and investment | "*My pronunciation and writing need be improved even more. I have many grammatical errors when speaking and writing, but I know that I can improve that doing the extra activities using my computer at home*." E-portfolio Self-assessment, Student 5, December 2015 |
| importance of building social relationships | "*Miss M was very happy and enthusiastic about the progress I had made. That of course encouraged me to continue giving my best. Better grades appeared more continuously and that made me very happy… ….I have improved in my weaknesses thank to my teachers and my classmates. It was hard for me, but I could learn anyway*" E-portfolio Self-assessment, Student 9, December 2015 |
| evolving empowered learner and teacher identities | "*I can develop more my weakest skills, where I can improve more my English, where I can put all my energy to show everybody that I really can*." E-portfolio Self-assessment, Student 2, December 2015 |

*Tomas' Classroom Research Study*

Tomas, from the outset seemed keenly interested in pursuing a technology-supported reflective research initiative in his classroom. His particular study was aimed at increasing the critical thinking of his students and their abilities to communicate their thoughts in English but using a social networking site as an interface for this activity. The focus was on pronunciation and the kinds of feedback the nineteen pre-service teacher students in his classroom gave to one another with regards to their recorded oral performances. The feedback was expected to be regularly uploaded on their personal blogs (Edublogs). He based his study on an earlier inquiry by Arslan (2014) that showed that among a group of teachers in training in Turkey, encouraging critical feedback on e-portfolios as opposed to on paper had positive implications for their future teaching practices with new technologies. This study focused on feedback for writing, whereas Tomas' study was interested in the use of e-portfolios for improving oral skills.

Analysis of the data generated in the blog and corroborated by data from the focus group interviews and written comments on e-portfolios indicated clearly that the level of critical awareness as well as the ability to communicate this awareness in writing had improved. Along with these metacognitive changes, there was also strong evidence of other changes in this group of future teachers in Tomas' classroom. These other changes, closely supported by our theoretical framework are summarized in Table 2 along with representative examples from the data on which they are based. Once again among these results, is the important finding that these participants recognized the role that technology played in supporting the encouraging changes they experienced in their learning.

**Table 2**: Summary of findings – Tomas' Study

| Finding | Representative quote from the data sets |
|---|---|
| Learning as dialogic | *"Another advantage of this activity is that when we give feedback to each other, we are proving to ourselves that we know English and we can learn from each other too, I mean, how they explain the mistakes in a clear way."* (Excerpt from E-portfolio comments, November 18, 2015 |
| Imagined identities as future teachers | "*I have to say that this have been useful for me……. because I'm actually learning how to be a teacher, how to correct pointing the flaws but also a lot of strengths. Everything is about balance between both, saying the right things, giving a good feedback and also, and the most important thing it's be nice."* (Excerpt from E-portfolio comments, November 18, 2015 |
| Evolving empowered learner identities | "*It gives me self-esteem when I give feedback. I realize I know English. I feel happy*." Focus group interview, November 20, 2015 "*And now there is more confidence and we say things and we don't worry".* Focus group interview, November 20, 2015 |
| Importance of community-building to learning | "*I thought at the beginning many of us take it [correction] personally but then we [began to] know each other and* [then] *we know it's part of the activity. At the beginning we were strangers and now we know each other*." Focus group interview, November 20, 2015 |

| Finding | Representative quote from the data sets |
|---|---|
| Potential to use technology in the future as teachers | *"In addition, it is quite useful because we are going to be English teacher in the near future, so it is a good way* [using e-portfolios] *to start to give feedback according to the things that we already know in order to help our classmates and improve our knowledge too, because we are going to do the same with our future students."* (Excerpt from E-portfolio Comments, November 18, 2015 |

*Comments on the Teacher Educators' Research Initiative*

The findings that we have described above from Marta and Tomas' respective classroom-research studies provide an insight into the outcome at the level of the researcher/teacher educator initiative that the lead author set out to establish. The limited uptake of the initiative, three of the twelve teacher educators who attended the initial interest-gathering meeting, could be considered disappointing. On the other hand, the success of especially two educators in influencing multiple changes through their classroom research studies, is indeed notable. Yet, changes were not confined solely to the pre-service teachers who benefitted from the use of technology in their teachers' teaching strategies. An excerpt from the reflective journal that Marta herself wrote at the end of the project illustrates the influence of the community of practice that was established with the lead author and Tomas on her own emerging research skills and use of ICT. It was this community–building that eventually helped support her efforts to conduct the research. She comments:

> *I discussed it [my research project] with a peer teacher [Tomas] who was also conducting his project with the students and together we decided to ask my students to upload their tasks in the class blogspot. We also had some talks about our progress of our projects and this encouraged me to go along with it. He also mentioned that he had had some online conversations with Paula [researcher/fellow teacher educator] and we decided to have one together via skype next time. We did so and it took us no longer than 20 to 30 minutes. I learned two things. On one hand, to socialize and talk about our practices was richer than working by oneself and on the other, getting feedback and ideas from your peers clarified my thoughts and concerns on what I was doing. I learned. (Reflective Journal, Marta, May 2016).*

Marta's comment underlines the value to her of the meaning-making interactions that took place in the community of practice that had been formed among the three educators. These interactions were made possible with social networking tools, and compensated for the time and physical distance constraints that were factors in continuing in their first attempts at classroom-based research. Besides these tangible constraints that were overcome with technology, the data revealed that pedagogical constraints, i.e. established traditional ways of doing, were also challenged through the research initiative. Just as the teacher educators were gathering evidence of how the technology-supported research they were conducting in their classrooms was influencing the pre-service teachers, technology was also influencing their evolving stance towards their own teacher education practices. Marta acknowledges these changes in her perspectives on teaching in the following comment that she wrote in her reflective journal:

> *From this 'project' learning experience, all my classes have had a different approach: use of technological resources. It is hard, initially, to move away from the comfort zone, but once one makes use of it [new social media technology] and sees the benefits, it is impossible to move back.*
>
> *(Reflective Journal, Marta, May 2016).*

Marta's words speak profoundly of witnessing how the affordances of technology were able to support her classroom research, resulted in convincing her to change her pedagogical perspectives. Indeed, she suggests that there is no going back. The powerful role that teacher educators can play in influencing the integration of technology into pre-service's teaching practices, is being established in recent studies (Misha and Koehler, 2006; Charbonneau-Gowdy, 2015, 2015a). Based on the results of our concurrent studies, it seems evident that Marta will be joining the ranks of those, albeit still too few, who have actively adopted ICTs in TE contexts.

The research experience for Tomas had added benefit in terms of the advancement of ICT in teacher education. From the outset, Tomas was quite comfortable with adopting new generation technologies, indeed his Masters' thesis was on the subject of e-portfolios. Yet, in analyzing the data from both levels, i.e. the classroom and the teacher educator/researcher level, it was evident that Tomas gained a greater agency in his own professional life, normally quite a struggle for educators in a context like Chile. In so doing, Tomas was able to assume an empowered identity as a teacher educator and future researcher. A comment in his reflective journal clearly indicates the letting go of his normal “do-it-alone” stance and his openness to work more closely with others in a joint presentation of our efforts to a gathering of teacher educators. In his classroom, he provided an agentive opportunity to his students to assume some of his role as teacher, and importantly, he speaks proudly of his active continuation of his research on e-portfolios. For teacher educators to be effective models of quality teaching, including daring to integrate ICT in their practices when others are not, they themselves need to be empowered and assume control over their professional lives. Tomas through this AR initiative with ICT showed evidence of doing so.

## 5. Conclusion

In this report, we have outlined the steps we have taken to reduce the gap between teacher educators who use ICT and those who don’t. Indeed, the process of this study has shown clearly to be transformative (Illeris, 2014) on both the teacher educator level, to Marta and Tomas, as well as among the pre-service teachers who experienced the changes in Marta and Tomas’ teaching at the classroom level. One might easily conclude that such social and professional transformations are not necessarily dependent on current e-learning tools. There may be some basis to that view. Yet, our response would be that clearly in the Chilean context in particular we strongly believe that these encouraging transformations both at the teacher educator and prospective teacher level would not have been possible *without* the integration of current social-networking tools. Chile with its engrained traditional attitudes towards learning and the disempowered role that teachers assume in this context, not to mention the challenges involved in building community through face-to-face contact due to physical distances and heavy workloads, pose multi-layered issues that defy new ways of thinking and doing. We come to these conclusions through the findings reported here and based on our earlier research (Charbonneau_Gowdy, 2015) that indicates clearly that for the TPACK model to be effective in influencing emerging teachers to adopt social-networking tools proven to lead to effective social cultural theory-based teaching approaches, we need the greater community of teacher educators in an institution to be “on board”. In view of the evidence that has been generated, we saw signs of jumping on board and encouraging implications for the use of e-learning practices from this initiative. This evidence points directly to the combined advantage of modeling and supporting classroom based e-learning research both for building community and empowering changes to pre-service teachers, our future educators, *as well as and most importantly* to teacher educators. We believe that more research-based initiatives such as these among teacher educators can promote moving out of one’s professional comfort zone at the classroom level. Initiatives such as these are crucial we conclude for increasing the breadth and depth of teacher educators’, and ultimately prospective teachers’, sustained use of quality e-learning practices.

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# E-Learning From Point Of View of Student of Elementary School Teaching

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**Abstract**: The starting point for the collection of the data and subsequent writing of the article was the agreement of EU Member States on promoting creativity and innovation of education through new ICT tools and teacher training. Professional teacher training is one of the EU priorities in the first cycle of the strategic framework for European cooperation in education and training ('ET 2020'). The research described in this paper focuses on the preferences of e-learning types among students of elementary school teaching with respect to selected factors, such as form of study, age, year of studies, gender, study program, etc. Primarily two major research problems were addressed: i) *What types of e-learning are preferred by the students of elementary school teaching?* ii) *Which factors influence the selection of certain types of e-learning?* A secondary/additional research problem was the question of impact of different levels of intelligences based on Gardner's Theory of Multiple Intelligences on the perception of e-learning among students of elementary school teaching. A questionnaire with high reliability score $\alpha$ = .87 was used as a research tool. It shows that the perception of e-learning is not influenced by any of Gardner's intelligences. The same conclusion can also be reached when the determining variable is gender and year of studies. Students of teaching frequently diverge in opinions concerning preferences of e-learning types regarding the form of study. It is preferred the least among students of full-time form of study and most preferred among students of combined form of study.

**Keywords**: e-learning, preferences, the theory of multiple intelligences, elementary school teaching

## 1. Introduction

Current development of technology adapts itself to various types of users. Sometimes we encounter technology offering information in a radically different way, than it was any time during our contemporary history (Laurillard, 2006). Such fast innovation offers many possibilities to educational institutions, but the main question still remains whether institutions are able to (and are willing to) use them adequately. This is the main factor this study tries to answer in the following paragraphs.

Back in 2002 at the European council meeting in Barcelona a requirement has been established for the European committee to accept the "eEurope action plan" (This plan was accepted by the EU in 2002 and was supposed to be applied by 2005, therefore the name: "eEurope 2005.") focused on wide range of accessibility for internet users all around the European union (EU) and the committee was asked to create the Ipv6 (As predicted, the IPv6 protocol was replaced by most frequently used IPv4) protocol (Beňová, 2007). This broadband internet connection should have provided fast and continuous internet access to all online services (European Union, 2010). The action plan was accepted and the rapid development of e-learning was imminent.

There are many different opinions on the e-learning use, for example the use e-learning for formal education standards (Květoň, 2003; Nocar, 2004; Kopecký, 2009) or for education programmes for companies and firms (Pavlíček, 2003). This contribution focuses on one concrete aspect of e-learning, similarly as the general view of Kopecký (2006) or Zlámalová (2009) and that is the e-learning use from the point of view of university students, specifically, future teachers in lower primary schools.

The limit of previously mentioned studies is low or no proof of psychological or socials aspects of online form of education. Only a limited number of Czech authors have contributed to this area, for example Zounek (2009). It is therefore evident, that there is no one specific evolution line for e-learning. The development of this learning differs depending on the area of use (e.g. business, military research, education or professional qualification courses) and even today the definitions for e-learning still differ based on the area it is used in (Nicholson, 2007)

## 2. Data research

The design of the research (Gavora (2010) and Chráska (2007) represents the basis for the research problem which may have the form of question or statement, more specifically: "Correctly formulated research problem is a question which should define the relationship between the variables" is quantitative and focuses on verification of these questions:

- What is the preference of the use of e-learning according to the area of use and what type of e-learning is preferred by students?
- What are the biggest advantages and disadvantages of e-learning?
- Which factors influence the choice of specific type of e-learning?

The data collecting was done by an online questionnaire which was filled in by 78 respondents. To assure the reliability of the study research tool standard pedagogical research methods were used. Five level answer model of answers in the questionnaire based on the Likert scale (Likert, 1932) was used. The Cronbach $\alpha$ coefficient (Cronbach, 1951; McGartland Rubio, 2005), which helps to find out the inner consistency of the research tool and can be used as valid when values are between the interval $\langle 0,1 \rangle$ and the generally accepted values of the coefficient vary from .7 to .95 (Tavakol & Dennick, 2011) was calculated. The questionnaire showed high reliability $\alpha$ = .87.

## 2.1 Types of e-learning based on preference

Because of the fact that the term e-learning evokes automatically the online-synchronic form in the minds of the majority of undergraduate students (based on the pre-study) the questionnaire also included an explanation of individual forms of e-learning. Offline e-learning means that no internet connection is required (based on CD material, or offline app etc.). Online e-learning then of course requires internet access. Synchronic form means direct communication with the lecturer/professor of the course. Asynchronic form is realised via e-mail or other digital form of communication. M-learning is mobile learning realised via smartphone app or conference call. Respondents had the opportunity to choose between several basic types of e-learning, which were the offline form, online-synchronic form, online asynchrony form and M-learning (Naidu, 2003). Each of the types had five items to choose from i) excellent choice, ii) I think I could use this type, iii) neutral opinion, iv) I don't think I could use this type and v) This one doesn't seem to make sense to be used. Individual answers were transferred into the following table:

**Table 1:** Selection basic types of e-learning

| | i | ii | iii | iv | v |
|---|---|---|---|---|---|
| Offline | 6 | 36 | 19 | 11 | 7 |
| Online-synchronic form | 21 | 31 | 13 | 14 | 0 |
| Online-asynchronic form | 15 | 34 | 20 | 5 | 5 |
| M-learning / M-learning | 4 | 20 | 19 | 20 | 16 |

If we count the items i) and ii) into the group of positive criteria, then the form of e-learning with most positive rating is the online-synchronic form closely followed by the online-asynchrony form. The emphasis while choosing the form of e-learning should be put on the electronic system which controls the learning process - Learning Management System (LMS). Bednaříková (2006) points out the necessary aspect of careful observation of attributes providing comfort while learning for the users of e-learning.

An important question is also what the target group for e-learning is. The current tendency in education is to view e-learning as a widespread accepted education methods suitable for all levels and types of education. The preference sample taken from the respondents can be observed in the following table:

**Table 2:** Preference of e-learning use in relation to the area of interest

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| company education | 17 | 26 | 26 | 4 | 5 |
| extracurricular education | 18 | 27 | 20 | 8 | 4 |
| general formal education | 10 | 31 | 24 | 9 | 2 |
| formal education – lower primary | 2 | 16 | 13 | 20 | 27 |
| formal education-higher primary | 3 | 30 | 17 | 17 | 12 |
| formal education – middle schools | 11 | 38 | 18 | 8 | 3 |
| formal education – college/university level | 25 | 40 | 8 | 6 | 0 |

1 – completely agree, 2 – partly agree, 3 –neutral, 4 – partly disagree, 5 – completely disagree

The biggest potential for using e-learning was detected as the college/university level e-learning. To compare these findings with other studies we have to keep in mind that there are authors who are sceptical towards use of e-leaning at this education level (Burbules, 2000, Noble 1998), but also authors who are trying to prove its positive outcome (Talent-Runnels et. al. 2006 etc.) that is why the comparison of such studies is very difficult.

## 2.2 Advantages and disadvantages of e-learning from the teacher trainee (primary school teaching program) point of view

This study was realised via questionnaire handed to university students. The questions contained information about advantages and disadvantages of e-learning. The individual item model began with a simple task: „Here are several statements about e-learning characteristics. Circle the appropriate number reflecting your opinion. (1-completley agree, 2-partly agree, 3-neutral, 4-partly disagree, 5-completley disagree). The items which included either positive or negative feedback were mixed up in the set.

**Table 3:** Advantages and disadvantages of e-learning from the teacher trainee point of view

| Observed area | Absolute value | | | | | Percentage | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| **Flexibility** | 39 | 29 | 4 | 4 | 2 | 50 % | 37 % | 5 % | 5 % | 3 % |
| **Technical issues** | 12 | 36 | 24 | 4 | 2 | 15 % | 46 % | 31 % | 5 % | 3 % |
| **low motivation** | 12 | 33 | 19 | 12 | 2 | 15 % | 42 % | 24 % | 15 % | 3 % |
| **convenience** | 36 | 33 | 7 | 2 | 0 | 46 % | 42 % | 9 % | 3 % | 0 % |
| **requirements for PC use** | 55 | 18 | 3 | 2 | 0 | 71 % | 23 % | 4 % | 3 % | 0 % |
| **Accessibility** | 34 | 30 | 9 | 3 | 2 | 44 % | 38 % | 12 % | 4 % | 3 % |
| **feeling of isolation** | 12 | 21 | 25 | 17 | 3 | 15 % | 27 % | 32 % | 22 % | 4 % |
| **simple modernisation** | 16 | 39 | 19 | 4 | 0 | 21 % | 50 % | 24 % | 5 % | 0 % |
| **dependent on technological security** | 39 | 20 | 16 | 3 | 0 | 50 % | 26 % | 21 % | 4 % | 0 % |
| **effectivity** | 10 | 34 | 24 | 10 | 0 | 13 % | 44 % | 31 % | 13 % | 0 % |
| **challenging for the content creating** | 11 | 27 | 32 | 8 | 0 | 14 % | 35 % | 41 % | 10 % | 0 % |
| **decrease of travel expenses** | 51 | 17 | 7 | 1 | 0 | 65 % | 22 % | 9 % | 1 % | 0 % |
| **supressing of human direct communication** | 40 | 22 | 11 | 3 | 2 | 51 % | 28 % | 14 % | 4 % | 3 % |
| **individual tempo** | 33 | 36 | 5 | 2 | 0 | 42 % | 46 % | 6 % | 3 % | 0 % |
| **not suitable for some areas of education** | 34 | 32 | 11 | 1 | 0 | 44 % | 41 % | 14 % | 1 % | 0 % |
| **Information perception** | 8 | 36 | 28 | 6 | 0 | 10 % | 46 % | 36 % | 8 % | 0 % |
| **Interactivity** | 14 | 36 | 19 | 6 | 3 | 18 % | 46 % | 24 % | 8 % | 4 % |
| **Communication possibilities** | 7 | 31 | 21 | 12 | 5 | 9 % | 40 % | 27 % | 15 % | 6 % |
| **Student anonymity** | 20 | 24 | 24 | 8 | 2 | 26 % | 31 % | 31 % | 10 % | 3 % |
| **Individual approach** | 21 | 29 | 12 | 9 | 7 | 27 % | 37 % | 15 % | 12 % | 9 % |
| **student material accessibility** | 34 | 37 | 5 | 0 | 0 | 44 % | 47 % | 6 % | 0 % | 0 % |
| **Accessible education for disabled students** | 53 | 16 | 8 | 1 | 0 | 68 % | 21 % | 10 % | 1 % | 0 % |

It is interesting, that even though the preparations of the study content for individual home study in the form of e-learning requires new pedagogical competence (Veteška, Tureciková, 2008, Zlámalová, 2008), this factor was not seen as a barrier by the majority of the student respondents.

Not even the feeling of isolation seems to be the issue. This finding is surprising because according to Brown (2011) the feeling of a student that he or she is a part of the community important for his/her positive outcome in learning. Watkins (2005) even states that students mostly complain about their isolation during e-learning courses. 40 percent of respondents partly agree with the support of communicative skills in e-learning. These mechanisms however can work because the feeling of belonging into a specific community doesn't have to be created and students then have no reason to contribute in online discussion. This may occur because the author may not react to the post for a long time or there may be some other technical difficulties, the environment for the discussions may seem chaotic and students then focus their attention to other activities within the e-learning course etc. (Mason, Rennie, 2006). One of the main positives pointed out by student is the financial factor of saving money by not having travel expenses, flexibility and convenience of the courses. The big paradox here is that the accessibility was regarded as an advantage when students on the other hand are afraid of relying too much on the technological equipment. Generally speaking, if a teacher decides to focus on ICT then he or she focuses more on the technicalities more than on the didactic aspect of the work (Law, 2008; Mishra, Koehler, 2006). An undeniable advantage of e-learning is of course accessibility for any disability. This way all students can participate in courses which would be otherwise impossible for some disabled students to attend. Other advantages included for example the distribution of study materials, fast feedback or the possibility of adapting to individual needs and study tempo (Oreški, Savić, 2013).

## 2.3 Factors influencing the e-learning preference

Some of these factors included into the study which correlated with the result were found to be either sex, age, form of study program (either part-time or full-time), study year and intelligence rate according to Gardner's theory of multiple intelligences (Gardner, 1999). The reader has to take into an account that the respondents were university undergraduate students of the lower primary school study program and our interest was influence this study program has on selected factors of e-learning preference in primary schools.

For the correlation of study program form and study year the Parsons $\chi^2$–test was used to create contingency table (Pearson, 1900). It is important to first verify the normality of data – specifically the age and intelligence rate factors according to Gardner's multiple intelligences theory. The normality data test war realised via Shapiro & Wilk test (Shapiro & Wilk, 1965) which tests the aspects compared to the null hypothesis which states that the data have normal distribution. Based on the normality test parametrical and nonparametric statistical methods were chosen. The discovered values of the *p*-level are shown in the following table:

**Table 4:** Factors influencing the e-learning preference (*p*-level value) – part 1

| Observed area | *p*-level value |
|---|---|
| Age | *p*=.00023 |
| Language intelligence | *p*=.31042 |
| logical and mathematical intelligence | *p*=.26831 |
| music intelligence | *p*=.17044 |
| kinaesthetic intelligence | *p*=.53324 |
| spatial intelligence | *p*=.49102 |
| interpersonal intelligence | *p*=.23866 |
| intrapersonal intelligence | *p*=.12418 |

Only the age factor required the use of nonparametric statistical method (according to the other than normal variation of the data). All other factors will be analysed by statistical methods which correspond with data with normal variation. As one of the parametrical methods the Student t-test (Chráska, 2007) was used to compare two groups of respondents. In order to compare more than two groups we used one-factor ANOVA test (Hendl, 2012) followed by post hoc analysis via Fishers LSD test. Nonparametric values for more than two groups required the use of Kruskal-Wallis ANOVA (Kruskal & Wallis, 1952). The null hypothesis was repeatedly tested which states the independence of student e-learning preferences within selected factors. The p-level values can be observed in the following table:

**Table 5:** Factors influencing the e-learning preference (p-level value) – part 2

| Monitoring area | *p*-level values |
|---|---|
| Sex | *p*=.72812 |
| Age | *p*=.77253 |
| Form of study program | *p*=*.92495* |
| Year of study | *p*=.49986 |
| Linguistic intelligence | *p*=.37216 |
| Logical intelligence | *p*=.70184 |
| Musical intelligence | *p*=.90486 |
| Kinaesthetic intelligence | *p*=.57612 |
| Spatial intelligence | *p*=.60155 |
| Interpersonal intelligence | *p*=.81788 |
| Intrapersonal intelligence | *p*=.63883 |

It is interesting that *none* of the previously mentioned factors significantlyy influences the preference of specific e-learning type. Our study predicted that the dependency will manifest itself especially in the areas concerning interpersonal intelligence or movement intelligence which did not.

# 3. Conclusion

With the fast ICT development there are also more and more questions regarding the Web 2.0, where passive participants and users will turn into active ones (Pitner, Drašil, 2006). Such new trends are described by connectivism (Siemens, 2004). In the midst of information intake and in connection to e-learning other interests are being highlighted at the expense of the interests of children. That is why this study chose college and university students of primary school teaching programs as the target group.

The study showed that students of the primary school teaching programs evaluated the primary school as the level of education with least potential for the use of e-learning. This form of learning was on the other hand regarded as preferred on the university level of education with the use of online synchronic form. Authors of this article also agree with this choice. It is true that electronic education materials can seem more attractive than materials in physical paper form and also can offer higher level of interactivity (Sharma, Barrett, 2007). If a good preparation of such courses will be overseen according to the ISD (Instructional Systems Design, Kopecký, 2006), the courses can then include also different styles and strategies to choose from (Marryl; Drake; Lacy; Pratt; 1996). Many of these advantages of e-learning will not be realised in practice when we talk about applying them on the primary level of education or even pre-school education where children learn mainly by selective associating and mimicking others (Řezáč, 1998) which is important for learning and acquiring behavioural and social skills in specific situations connected with work or school. *If future primary school teachers are to be prepared for their job, we don't see it as suitable for them to base their teaching preparations on any of the e-learning forms.*

Significant amount of students still sees the problem of e-learning use in the user competence and the knowledge how to manage with a PC (71 %), supressing of direct communication situation between participants of e-learning (51 %) and the dependence on good security level (50 %). It is interesting that only 14 % of the respondents regard the e-learning preparations as difficult to manage even though they had no prior experience in preparing online study materials. The biggest advantages were then seen as: the accessible study programs for disabled (68 %) decrease of the travel expenses (65 %) and flexibility (50 %).

Factors which could have influence on the e-learning preference in this study were reflected by the age, sex, study form, year of study and individual intelligence type based on the Gardner theory of multiple intelligences (Gardner, 1999). The results shown, that there is no statistically significant dependence between the previously mentioned factors and the e-learning preferences. The hypothesis expected mainly interpersonal and intrapersonal intelligence to have significant dependence.

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# *Taking Making into Schools* Through Immersive Professional Learning

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**Abstract:** Globally, the Maker Movement is gaining momentum and finding its way into educational environments – primary grades to college and university. Defined as a convergence of emerging technologies (i.e., 3d printers, CNC tools, etc.) with the DIY (Do It Yourself) culture, the Maker Movement has captured the imagination of hackers and home crafters, encouraging them create innovative and creative items with a focus on using, learning, and applying practical skills. When taken into schools, the Maker Movement invites educators and their students to engage in active production rather than passive consumption of products, media, materials, and objects (Martinez & Stager, 2013). In formal learning settings, Making should be considered both a domain of study as well as pedagogical orientation. This paper shares findings from three years of an immersive professional learning approach, introducing Making to over 2500 teachers situated in diverse settings, including rural and urban western Canada and rural and urban Tanzania. We use the term immersive professional learning to refer to full day, participatory, hands on learning event that encourages active participation. Our approach requires the facilitator(s) to model both the process and the content so participants can learn by experiencing design thinking, prototyping, and reflection. Findings for this paper are drawn from participant workshop evaluations and reflections, author observations, thematic analysis of participant design sheets, and post participation emails which share ways in which Making has been taken into classes. Of significance is how the authors have taken key understandings of the face-to-face immersive professional learning and adapted them to an online environment. The online version of Taking Making into Schools was commissioned by two provincial government agencies, working together to imagine ways to disseminate professional learning into Making more broadly, recognizing access to online learning might be the best scalable approach for supporting transformational pedagogical change and integrating Making into classrooms.

**Keywords**: Maker, immersive professional learning, online learning environments, transformational change, MOOC

## 1. Introduction

The Innovative Learning Centre at UBC Okanagan conceptualized and hosted its first immersive professional learning event entitled Maker Day (http://innovativelearningcentre.ca/) in November 2013. The event was offered as a proof of concept, experiential learning day for teachers in answer to the question posed by the Industry Training Authority (ITA) – How can we attract more students to Trades and Technology programs and work to develop a highly Skilled Workforce in Canada capable of supporting advanced manufacturing? ITA is the provincial body that certifies trades professionals (http://www.itabc.ca/), and their question stemmed from a growing awareness that Canada was projecting a gap in terms of preparation of skilled workers and the need for that work over the next decade. ITA and the Conference Board of Canada recognize that advanced manufacturing – the marriage of enhanced technologies with traditional and emerging manufacturing is essential in an increasingly globalized and competitive marketplace.

This gap in the preparation of skilled workers is consistent amongst other industrialized nations, many who have tended to sort their K-12 students into academic versus vocational tracks, assuming that students interested in the trades would not attend universities and university bound students would not pursue careers in vocational or trades professions. The result, specifically in Canada, has been a steady decline in international metrics measuring our capacity for innovation and competitive economic advantage. The Conference Board of Canada has “given Canada a D for innovation” (Grant, 2015, par. 4), ranking it “ninth among 16 peer industrial countries [and] leaving it far behind class leaders like Sweden, Denmark, and Finland” (Conference Board of Canada, 2013). Matthew Crawford’s 2009 surprise best seller Shop Class as Soulcraft: An Inquiry into the Value of Work reminded educators and industry leaders of the false duality of academic work and shop work, reminding us that design and making are essential components to being human. Crawford suggested that somehow, in North America, we had lost our way and began to privilege consumption over creation and buying over making. He suggested it is important to reclaim the worthiness of craft and making. In following Crawford’s suggestions and in embracing the potential and promise of the Maker Movement, we believe we can foster the optimism of design and joy of making re-introducing it within our schools to foster creativity and innovation and the pleasure of tackling problems and projects worth doing. What Papert (2011) called hard fun. "We learn best and we work best if we enjoy what we are doing. But fun and enjoying doesn't mean 'easy.' The best fun is hard fun. Our sports heroes work very hard at getting better at their sports. The most successful carpenter enjoys doing carpentry."

## 2. *Taking Making into schools* – a description of the immersive professional learning approach

Bringing Makerspaces and Making into schools is currently a global educational focus. Blogs, websites, professional development activities are rife with Maker activities, kits, and resources. However, if Making is to move beyond the hype of rushing to acquire 3d printers and other emerging and trending technologies and digital toys, we believe educators must pause to consider what Making actually is and how it might be both a pedagogical orientation and a domain of study.

Our approach to creating that much needed professional pause is to offer educators immersive professional learning (IPL) that focuses on the elements we have found to be critical to understanding the role Making can play in classroom learning. Those elements include designing, tinkering, thinkering and reflection as illustrated in Figure 1- Maker Immersive Professional Learning Cycle.

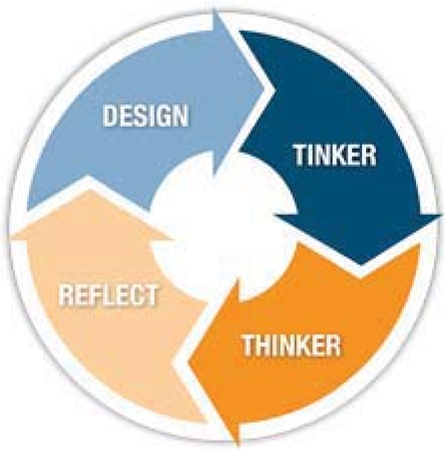


**Figure 1:** Maker Immersive Professional Learning Cycle

Design is experienced through a facilitated modification of Stanford University's d.School Design Thinking process (http://dschool.stanford.edu/dgift/). Design thinking requires participants to engage in questioning to gain empathy to the design challenge and promote divergent ideas to disrupt the rush to problem solving by inviting problem finding. Problem finding, as experienced through empathetic questioning, helps participants to see a challenge from alterative points of view. The structure of the design thinking process holds space for participants to have their say, to tell their stories, do their necessary research and thinking, and explain their ideas. While initially some participants find the design thinking process rigid, the overwhelming majority ultimately find it liberating and positively disruptive.

As an extension of the design process, participants use a range of technologies and materials to Tinker - modify / enhance and/or improve their designs. Our liberal use of the term technology draws from the Association for Educational Communications and Technology (Januszewski & Molenda 2007) definition of a technology as a tool to enable a human capability; therefore, we view technologies as a range of tools from simple hand tools to 3d printers to computer assisted drafting software. Tinkering requires participants to grapple with technologies and materials that many find unfamiliar and potentially daunting. However, with the scaffolding (Vygotsky, 1978) of just-in-time learning, safety tips and equipment, and peer mentoring, participants embrace Making as a way tangible, experiential way of demonstrating their thinking and learning. Scaffolding allows participants to do more with the support of experienced peers than they could do by themselves.

Thinkering occurs as participants share their ideas and initial designs and tinkering and begin to see a range of ideas surfacing. Michael Ondaatje used the term thinkering in his novel The English Patient, to "suggest collecting a thought as one tinkers" (p. 39). We have found that as participants lose themselves in the design and tinkering process, they relax their need to rush to a solution and begin to thinkering, collecting ideas and considering other ways of working and being. This surrendering to the process appears to open creativity and imagination and supports innovation and design iterations.

Reflection is essential in to the cycle of immersive professional learning. Educators must be allowed the time to think about both the process and the product of their personal learning and then consider how that learning might impact and / or be incorporated into their professional practice. Reflection as part of the Making process is also essential in that it reminds participants that imagination and creativity do not have a fixed start and stop, they are cyclical and recursive. All too often we use language such as we are starting projects and then stopping them at a pre-determined time. Innovation and design are continuous and iterative – ideas build on ideas and designs are improved through tinkering and thinkering. Reflection provides the a ha moment for educators to pause and consider the importance of process and product, thinking and making, and the power of integrating habits of mind, heart and hands in the making of tangible things. It is in this very personal growing understanding of Making that educators who would not have considered themselves Trades Teachers or Skilled Laborers find the joy of Making and the need to make things and then make those things better. It is through this process of discovery that participants come to understand the importance of design as an optimistic, empathetic way of engaging with a complex world. It helps participants realize they can be proactive and design changes that might make a significant difference. With their growing understanding and rich communications with colleagues they can the confidence to take making into their classrooms and creative opportunities for their students, K-12, to embrace the false duality of academic work and shop work.

To initiate the Design process, we create Design Challenges appropriate to the context of the professional learning participants. The design challenges are written in an open-end, scenario-based format that supports multiple solutions to real concerns. Because design thinking is an empathetic, human-centred approach to problem finding, challenges must be situationally relevant and inclusive. We view the Design Challenge as the provocation for tinkering and design thinking is the process for problem finding. It is through iterative tinkering and thinkering that participants begin to work toward multiple solutions, engage with materials and technologies, and create imaginative and innovative solutions. Eisner's notion of making thinking visible is evident in the design notes and sketches generated during the design thinking process and the prototypes created during the tinkering (1998).

Our work suggests that when educators are allowed to participate in immersive professional learning, they can begin to engage in the essential conversations they need to embrace the potential, place and promise of innovative practices in their classrooms. As DeMonte (2013) notes,

> *Professional development in education has gotten a bad reputation, and for good reason. Everyone on all sides of the education reform and improvement debate agrees that what most teachers receive as professional opportunities to learn are thin, sporadic, and of little use when it comes to improving teaching. According to Harvard University Professor, Heather C. Hill, the 'professional development 'system' for teachers is, by all accounts, broken.' One likely reason for this view held by Professor Hill and others is the reliance on short-term, episodic, and disconnected professional learning for teachers—the kinds of training programs that are unlikely to positively in influence teaching and improve student achievement. It takes sustained investment of time into teacher training to change instruction and improve classroom outcomes (p. 1).*

Our work suggests that immersive experiences help educators to develop an intentional mindset that allows them to position new ways of working with children within their classrooms and embed Making within curricular areas and pedagogy. Creating opportunities for educators to experience Making appears to help them to nurture innovative and creative thinking through design and tinkering. Figure 2 illustrates the recursive nature of experiences needed to building an intentional mindset. By introducing educators to a design challenge and then facilitating them through a design thinking process, they are encouraged to nurture innovative, divergent and creative thinking. Design thinking prompts curiosity and helps educators to think laterally and find connections amongst ideas generated by others. The thinkering process supports educators to become empowered by their ideas and their growing confidence that they can design and make things and then collaboratively tinker to make those things better. This empowerment, in terms, appears to increase confidence and the willingness to take risks and explore.

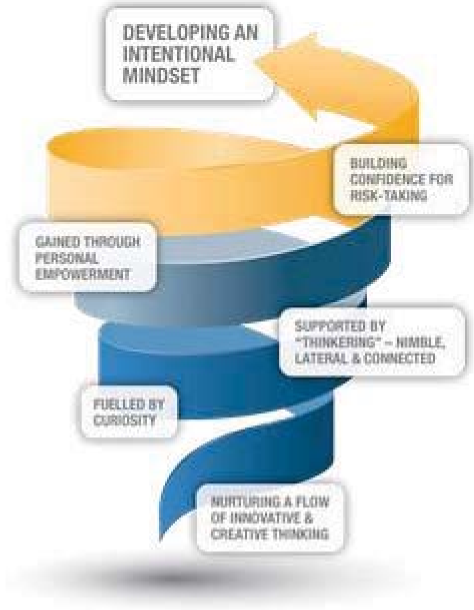


**Figure 2:** Fostering an intentional mindset

## 3. Findings from our immersive professional learning events

Since 2013 we have worked with over 2500 educators in Maker immersive professional learning events. Three primary issues have emerged from our work that inform our next steps in moving these events into an online environment.

First, is the importance of time to pause, experience, consider and reflect on each element of the design thinking process. Stanford identifies the five steps, which are illustrated in Figure 3 – Steps in the Stanford Design Thinking Process (Stanford University Institute of Design, 2016). While educators can download resources and toolkits from sites like the K-12 Lab Network wiki (Krummeck, 2015), access to materials is not the same as experiencing the process and being provided the time and space to tinker and thinker with colleagues.


**Figure 3:** Steps in the Stanford Design Thinking Process

Second, is the importance of working through the frustration, negotiation and conversations needed to share ideas, move those ideas to an action design, and then continuously tinker with a prototype.

Third, we have tended to under value the importance of the design challenge as a provocation for Design Thinking and Making.

Our recent work has led us to co-develop design challenges with educators. This work has proven harder than we initially imagined it would be, and those findings are beyond the scope of this paper. Our work with educators reminds us they tend to be very critical consumers of professional learning. They must be fully engaged in thoughtfully designed, immersive and disruptive learning events if they are to experience new pedagogical orientations and then reflect on new ways of working as active collaborators in small groups (Crichton & Carter, 2015; Crichton & Vikiru, 2015). The Design Thinking process is an essential element of this disruption as it requires full attention and participation. It fosters empathetic conversation and holds the space for individuals to think, create and innovative.

### 3.1 Research methods and data

Findings for this paper are drawn from participant workshop evaluations and reflections, author observations, thematic analysis of participant design sheets, and post participation emails which share ways in which Making has been taken into classes. Of particular importance has been the pre- and post- professional learning event discussions with site organizers and participants. Carter, acknowledged in Section 5 has remained in contact with many of the educators we have worked with since 2013. Issues of impact and scale are the focus of her current doctoral research and therefore, are not included in this paper.

### 3.2 How findings informed design of online professional learning approach

In keeping with the intentions of the Maker Immersive Professional Learning Cycle (Figure 1), when we began considering what style of online delivery to consider we initially looked to the MOOC and its variants as many of the design assumptions appeared to be consistent with our intention for scalable knowledge dissemination across multiple audiences with various learning needs. A generally accepted definition of a MOOC is that it is

> *a model of educational delivery that is, to varying degrees, massive, with theoretically no limit to enrolment; open, allowing anyone to participate, usually at not cost; online, with learning activities typically taking place over the web; and a course, structured around a set of learning goals it a defined area of study" (Educause, 2013, para. 1).*

Anders (2015) further classifies MOOCS as either cMOOC's; xMOOCs, or hybrid MOOCs. Whereas xMOOCs tend to adopt a cognitivist-behaviourist approach, cMOOCs are "learning experiences [that] are to be networked, open and decentralized… the goal of cMOOCs is to facilitate emergent, self-organized patterns of collaborative learning" (Anders, 2015, p. 2). It has been argued that at their core, all MOOCs are hybrids (Roberts, Waite, Lovegrove, & Mackness, 2013); however, in general there is an acceptance that each type of MOOC has a predominant orientation: content (xMOOC), task (hybrid MOOC) or network focused (cMOOC) as discussed by Lane (2012) and (Beaven et al., 2014). In contrast to the MOOC, variants such as Spoc's (small, private, online course) increasingly emerge on the educational landscape (Burns, 2016).

In 2008, Crichton and Childs offered a continuum of pedagogical approaches to illustrate the various ways in which learning takes place in the intersection between students, teachers and content. Recognizing the continuum was drafted in 2008, we have updated the pedagogical possibilities considering the classifications of MOOCs as identified above and recognizing that students' needs change when courses are offered as ungraded / not for credit self-study, facilitated asynchronous learning for credit, and blended learning (combination of online and campus learning experiences. We believe that central to quality pedagogy is the importance placed on the instructor and learners' shared understanding of the options, opportunities and unintended consequences of the instructional design of each course and the types of supports, both soft and hard technologies, that enables it.

One of the significant aspects of MOOCs in all of their variations and other related open online courses is the way that they have fostered a re-examination of the "sources and process of higher education" (Educause, 2013). Using a MOOC to reduce barriers to access of education and to foster learning as a lifelong endeavour resonated with the project team associated with the Taking Making Online project as it provided a scalable structure for disseminating professional learning more broadly and was consistent with the values of the Making Immersive Professional Learning Cycle. As we designed an online experience, it was clear that it would be the educators' personal learning goals that foster the uptake of and application of this resource. To that end, the flexibility and inclusivity of adopting a MOOC approach appeared to be consistent with the self-directed yet networked nature of the work. As Milligan and Littlejohn (2014) state

> *MOOCs potentially allow for personalized learning by giving professionals opportunity to align formalized learning with their practice, learning (via the network) with others who share similar and complementary experience and expertise. …Their potential depends on how professionals align their personal learning goals with learning in the MOOC" (p. 2).*

This self-directed yet networked nature of the work is a key component of emergent learning as summarized by Anders (2015). A characteristic of emergent learning is to "leverage network connections to solve problems and grow capacities for self-directed learning" (Anders, 2015, p. 3) which would appear to be consistent with the intention of immersive professional learning as defined in this paper and supported our decision to adopt a MOOC approach for the Taking Making Online project.

## 4. Next steps

The three issues that have emerged from our immersive professional learning events outlined in Section 3 above have been central in the selection and design of the MOOC learning experience for the Taking Making Online project. Using a variety of instructional strategies supported by the affordances of technology, we have intentionally build in spaces and places for participants to pause, experience, consider and reflect on each element of the design thinking process in the MOOC. Applications such as Photo Reflections, Penzu, and the use of asynchronous forums and a shared Twitter hashtag have been incorporate into the MOOC to build on the ability of MOOC's to foster emergent learning. In doing so, we have attempted to scaffold and support the participant learning experience in the MOOC as they work through the frustration, negotiation and conversations required by the design thinking process. By integrating virtual collaboration tools such as Samepage, Trello and others, we support the participants as they share, discuss and move ideas to an action design, and then continuously tinker with a prototype. By intentionally having participants experience and then create a design challenge in the MOOC that is then used, adapted and reflected upon by the individual and the larger MOOC participants, we endeavoured to highlight the importance of the design challenges as the provocation to think, create and innovate and push participants to reframe problem solving as problem finding.

By approaching the design of the MOOC in this manner, we have been able to embrace multiple motivations for participation and create a learning experience that addresses three different learning needs. The MOOC initial offering supported a self-study, no credit (free offering). Modelling the design thinking process, this MOOC was then iterated upon and became part of a resource set for a facilitated asynchronous, for credit offering (for a fee). Building upon these two experiences, the MOOC was then used to support and inform a blended (asynchronous/on campus) for credit course offering (for a fee). By using the initial MOOC in this evolving manner, it made visible the iterative process of tinkering and thinkering and offered the opportunity for participants to engage in rich discussions with colleagues as they developed a growing understanding of how to foster an intentional mindset of Making in their classrooms and professional practice.

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# Technologically-Capable Teachers in a Low-Technology Context

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**Abstract:** Developing countries lacking the capabilities, funds and the human resources are compelled to improve the digital literacy rates of its task force through educational initiatives. This paper focuses on an in-service teacher education (TEd) project, The *TechAge Teacher Project* (TATP), which aims to equip teachers in Tunisia with the technology skills for teaching. Five English language teachers, recipients of this initiative, are studied to trace the process of their transition to the low-technology context in their schools. Questionnaire and interview data indicate that teachers show great dedication to implement some of the ideas/skills received in the training. They strive as technology-capable teachers to integrate technology in their day-to-day practice despite the constraints of the low-technology situation. Their accounts unveil their rationale and motives for using technology in their teaching, and the strategies they use to accomplish their goals. The findings highlight the teachers' resourcefulness and sense of mission as to changing their learners' attitudes towards technology use. Finally, recommendations are made for the emerging professional community of technology-capable teachers in the way of building networked community of practice to facilitate the dissemination of ideas on the integration of technology in education and how they can be translated into action.

**Keywords:** teacher technological pedagogical knowledge, 21st century skills, low-technology context, teacher transition to e-learning, technology integration, professional networks, Tunisia

## 1. Background

This paper probes the situation of five practicing secondary school teachers who in 2014 followed a nine-month training program in the use of technology in teaching. The Tech Age Teacher Project (TATP) which ran for two years (2014 and 2015) was funded by the International Research and Exchange Board (IREX) and the Blue Mountain Foundation (BMF). It was designed to train public school teachers in Tunisia in technology use for teaching/learning. The TATP was administered in collaboration with the Tunisian Ministry of Education and National Centre for Innovation in Pedagogy and Research in Education (CNIPRE). The programme was administered in three phases beginning with basic skills and scaling up to advanced communication and presentation tools. The programme was selective so that only thirty teachers reach the final phase. The training took place in selected schools or CREFOCs (Centres for Continuous Teacher Training) and select schools with the technology component run at the district level by regional coordinators who were certified Information Technology teachers (See Appendix 1).

As reported by Klibi (2014, p. 60), there is limited support for technology use in Tunisian public schools. The English teachers she studied had to bring their own laptops, internet access USB key, and could not rely on availability of the LCD project. The learners just watch their teachers use the technology and study from materials teachers downloaded from home. Studies in varied contexts (Becker, 2001; Teo, 2015) pointed to a host of interconnected factors influencing teachers' decisions to use or not use technology such as length of experience, availability of the technology, ease of use, and suitability to the learners' learning objectives. However, exceptionally enthusiastic teachers, as the ones in this study, need to go out of their way to engage in technology use due to the low-tech situation. Situations of limited resources in Tunisia and elsewhere (Egbert, Paulus and Nakamichi, 2002; Yildiz, 2007) can hinder the teaching of 21st century skills in the schools as teachers will have limited options (Goodwin-Jones, 2015; ISTE, 2008; Kennedy, Latham and Jacinto, 2016; UNESCO, 2002).

This study focuses on examining how five TATP trainees cope once back in the school context. Thus, the general aim of this study is to explore how these teachers manage, if at all, to transfer what they have learnt and how they reason about implementing technology-supported instruction in their work. Previous research on teacher learning showed that the trainees' knowledge is constructed and refined in-action (Freeman and Johnson, 1998; Schulman, 1986). More specifically, teachers learning to use technology tend to expand their pedagogical knowledge and develop expertise in integrating technology through experience by merging old and new knowledge in day-to-day practice (Chao, 2015; Messina and Tabone, 2012; Meskill et al., 2002; Tai, 2015; Wong and Benson, 2006).

## 2. Technology in teacher education

Ideas on how best to educate teachers to use technology changed over time. As computers and technology authoring tools became more user-friendly in 1980s, Levy (1997, pp 14-24) explained, teachers strove to balance the technical and pedagogical levels. This pedagogical concern was met by teacher education through the production of training textbooks and support materials for the classroom teacher, CALL materials for teacher educators, explanation of how theoretical frameworks can underlie practice (e.g., language learning methods, Second Language Acquisition, or learning theories) and the launching of social networks so that teachers access knowledge about CALL through collaborative processes (Hubbard and Levy 2006, pp 6-7).

An exploration of descriptive and research-based reports on existing pre-service and in-service technology training courses indicate that the dimensions generally covered include technology, theoretical knowledge and field experience (Lambert, Gong and Cuper, 2008; Slaouti and Motteram, 2006; Wong and Benson, 2006) but decisions about what type(s) of knowledge, what technology tools to select and in what sequence can be hard to balance. For instance, Hughes (2004, pp. 347-355) proposes designing "technology integration" courses around four guiding principles:

- Connecting technology learning to professional knowledge,
- Privileging subject-matter and pedagogical content connections,
- Using technology learning to challenge professional knowledge, and
- Equipping teachers with skills in using many technologies.

Meskill et al (2002), who compared the "technology talk" of novice and expert teachers, concluded that novices needed more time and hands-on application of technology to reach a balanced view of the place and role of technology in their teaching. The researchers pointed out that experience matters as teachers need to go through "sequential transition". They will learn to integrate technology by resolving issues related to classroom management, appropriateness of teaching approaches, and of technology tools. Wong and Benson (2006, p. 263) point to the issue of how individual teachers' beliefs about teacher control and learner role(s) in the learning process determine the level of success in integrating technology. Thus, the potential for training to transfer to the classroom is a complex process and may be limited as Robb (2006, pp 331-340) explains. For instance, the content of a course may not fit the type of assignment, the tools provided at university may not be available, the institution (or its administrative leaders) may not value technology use, students and teacher perceptions may differ on the role of the technology plays in learning, and so on.

Peters (2006), for instance, describes a solution adopted in Quebec to increase chances of technology training transfer. In this program teachers acquire first the basic technological skills and then undertake technology integration teaching projects. As is the case in Robb's (2006) study, student teachers report that being technologically-capable does not make them automatically successful in integrating technology in their teaching. They felt that the timeframe of a semester course was not sufficient for experimentation with technology integration in classrooms. Indeed, studies of the type gave universities indications that a better option is to integrate technology throughout their programs. A solution adopted by the University of Quebec consisted in introducing a webfolio requirement that student teachers needed to maintain over the four-year course of study. They also launched an online forum for the purpose so that they share their ideas and the projects they create. Thus, the belief was to infuse technology throughout the program in order to cultivate in the student teachers an integrationist view of learning with technology.

Slaouti and Motteram (2006) and Foulger et al (2012) describe similar moves at in their respective universities. Slaouti and Motteram (2006, pp 82-83) report that four technology modules are offered in the MA course (Computers and Video in the Language Classroom, Computer-Assisted Language Learning, Multimedia in Language Education, and Computers, Language and Context) but the program's philosophy is also influenced by views on teacher knowledge as complex (Schulman, 1986-1987), teacher learning as construction and reconstruction of experience, and professional growth as the outcome of reflection on practice as advocated by Freeman and Johnson (1998), Shavelson and Stern, (1981), and Zeichner and Liston (1996). Moreover, a CMC tool is infused in the fourth module whereby students are required to post their assignments and to justify their choices when designing teaching activities and share their reflections with fellow trainees. The program developers hoped that student teachers' "Technological Pedagogical Content Knowledge" (TPACK) would develop as part of the exchanges as anticipated in the account by Koehler and Mishra's (2009) TPACK, in itself an expansion of Schulman's (1986-1987) model.

Indeed, as a teacher knowledge framework, the TPACK continues to be explored in technology courses in the hope of combining areas of knowledge; subject-matter knowledge, technological knowledge, and situated pedagogical knowledge. Of interest is Charbonneau-Gowdy's (2015, p 237) work in which she evoked similar reasons for infusing online communication and networking tools (class blog, Skype, cell phones, web-based input, and group emails) in a TEd course in Chile. Attempts in other countries accompanied by a research agenda are also confirm the process of teachers making connections in-action (Messina and Tabone 2012; Tai 2015; Teo 2015).

Current developments in the field indicate that social networks and global professional communities as personalised open systems of continuous professional development (CPD) are gaining ground (Kennedy et al, 2016) in the sense that CPD opportunities are believed to be within the reach of every teacher. They can resort to free webinars and subscribe to specialised expert communities where they can exchange ideas with "expert" and "novice" professionals, ask questions or seek help. In these virtual spaces teachers become self-regulated learners, possibly designing their own CPD programme.

## 3. Research design

The study was carried out from an ethnographic perspective (Hammersley, 1992). It started with collecting information about the TATP and connecting with the wider population of teachers benefiting from the initiative. An invitation to the Tech Age Teachers Facebook page helped the researcher follow the second group of TAT as they were undergoing training. There were posts about training sessions taking place in the different districts, images of pupils working around computers, the creative work they produced and of officials visiting the training sites. The second phase consisted of collecting empirical data delving into the experiences as described by the teachers themselves.

### 3.1 Participants

Five English language teachers (three female and two male, aged between 25 and 35 years) took part in the study. They were all teaching in public schools and, except for one, had an experience of more than 10 years. A technique of purposive sampling was used so that only English teachers who had participated in the TATP were approached.

### 3.2 Data collection and analysis

The data collection started 18 months after completion of the training. First, the participants filled an email questionnaire to collect general biographical data and specifics of the teachers' previous experience with technology learning and current use of technology in their schools (See Appendix 2). In light of their responses, a semi-structured interview protocol was developed to probe the teachers' knowledge construction and detect instances of transfer of learning in the context of work. Their implicit and explicit theories about teaching with technology can emerge with reference to a specific teaching situation (Freeman, 1991). The participants were interviewed via Skype and *VoiceThread*, the data saved as MP3 files and transcribed.

## 4. Results

A case study analysis technique was adopted whereby the ideas were examined across-case in search for convergence and/or divergence in search for patterns and evidence for conceptualization of practice. This process of making-sense of the data (Patton, 2002) helped the researcher pin-point the teachers' lines of arguments, beliefs, and attitudes while remaining sensitive to any arising diverse positions.

### 4.1 Teachers' story with technology

The five teachers' story with technology began long before the course. In general, the participants described themselves as "computer literate," "computer savvy" or "skilled in using computers". For instance, Maya, the youngest participant, reported having used *Encarta* CDRoms for self-study as a pupil and that she learnt how to edit videos with her brother using the family laptop. Maya, Nora and Hassan also reported benefiting from courses on technology use provided by the Ministry of Education but found them sporadic and too limited in scope. As for their use of technology for teaching prior to the TAT experience, they were quick to point out it was "simplistic" (Maya) and "not integrative" (Nora and Helena). They felt the need for a boost professionally so that they could innovate and motivate their pupils. They indicate that they, as teachers, were feeling low and could see that their pupils were disaffected with school and the "old ways of teaching".

## 4.2 The TAT experience "transformed" my teaching

Thinking back about the TAT experience, the teachers admitted that even though they used the technology in their personal life, they found that the training helped them "transform" their teaching. For example, Maya described her initial attempt as teacher-centred and transactional in style:

> *I used to use the technology just in the form of a Powerpoint presentation as a tool to present ideas or concepts in a Powerpoint or include videos. This was a very simplistic use actually with zero interaction from my students. I was in control.*

Helena, on the other hand, mentioned that she used to just use videos that her husband had downloaded for her. The TATP experience helped the participants step into new roles as teachers. The questionnaire data indicate that they leant, each in his/her own way, to incorporate software use, develop multimedia materials, select curriculum-specific audio and video input, use Web 2.0 tools to create learning opportunities for their pupils (esp. Ramy, Maya and Helena) and coach them within technology clubs after school (Hassan, Nora, Maya and Helena).

They also highlighted the need for setting new educational goals that incorporate technology use. Helena explained: "We would teach the students the same skills we were taught and help them be 21st century students and use technology to communicate and to collaborate with others." Nora, Maya and Hassan insisted, especially, on fixing the learning objective(s) justifying the introduction of technology tools and expressed concern over prevalent "negative" attitudes they observe among learners. They complained that some of their pupils "only conceive of the technology as a futile entertainment tool" (Helena) or just "seize the opportunity to check their FB or email" (Hassan) instead of doing work. The five participants talked about the issue and showed determination to correct, what they considered, the "negative perception of technology as entertainment within the Tunisian educational culture" (Hassan). They felt they had to install in the pupils new habits of using technology for learning. Nora mentions teaching her pupils "how to create their own quizzes, questions about a comprehension text (using *Hot Potatoes*) or how to edit images they can use to explain a vocabulary word or concept". This type of involvement, she explained, will focus their attention on what she calls "good use of technology". For instance, she mentions employing a rotation system so that each is given a chance to experience using the devices:

> *... some do the drafting and the others can use the laptop to create a Powerpoint presentation for the project. One time I gave them the camera and told them to take pictures while the others could use the microphone to record themselves.*

It is clear from the teachers' accounts that they are careful with the implementation of teaching technology-supported activities. As they plan and manage the activities, they bear in mind the "real learning potential of technology" and the level of involvement of the learners. Hassan and Ramy pointed out that integrating the tools, content and type of learning activity is what makes a lesson technology-rich and successful; not the technology itself.

Another distinctive feature of the participants' practice teaching with technology is flexibility and caution. Nora said she could change her objectives around if need be and Maya that she could find a way to always have some aspect of technology present in her lessons. Helena mentioned that she is able to trouble shoot and solve the problem of connection. Hassan is weary of fads and fashions. He comments that introducing pupils to *Scratch* is not a priority from a language learning standpoint. He believes that language teachers should always focus on learning language with technology and only use the essential tools. For instance, he prefers to compile materials and bring them on CDRom for class use. He mentions experimenting with mobile use by running a texting competition, doing a simple search and allowing the pupils to access the group's Facebook page to consult the teacher's post that day. To do this, Hassan has to skilfully blend face-to-face and online work. Indeed, Hassan only relaxes his grip on technology when the risk of students engaging in "off-task behaviour" is reduced: "The challenge is to make them aware of the educational uses of the devices," he retorts. Nora, in contrast, holds the view that if her pupils develop sufficient familiarity with the technology tools, they will pursue learning on their own. Ramy is also relaxed about putting technology in the hands of the students. He encourages the pupils to bring their own mobile phones or laptops and supplements with communication through a class FB page. He argues: "students have sophisticated tablets, mobile phones, and laptops at home and they go to the internet cafés, so why not use [these affordances]?" He asserts that the pupils never complain about being given work to do with technology use whether in class or out of it.

A third feature of the transformative power of the TAT experience can be the participants' ability to create activities using their own teaching materials and to put pupils in an active role as learners who create and share with others what they have created. Maya explains:

> *....Now I can create interactive activities or a video-based lesson when the students can interact with the presented materials and get involved in further discussions. I also encourage my students to create digital stories, Powerpoint presentations, short animations related to whatever topic we are dealing with.*

Likewise, Nora relates how she can now use media and technology to motivate learners and involve them in creative work: "I try to have them watch videos and respond to the content in speaking or in writing. I have them sing along famous songs just to encourage them to speak and the like".

### 4.3 Strategies for technology implementation and integration

As mentioned earlier in the paper, the interest was in exploring the ways teachers made the transition at school level knowing that the technology situation differs from one school to another. Except for Helena's who was in a TATP selected schools, the other participants noted the poor infrastructure and lack of special classrooms but were optimistic about the prospect of change. Hassan says he just needed his laptop and wireless mouse and that all twelve English teachers in his school are indeed using technology against all odds: "We are using our own equipment and bringing our own devices and encouraging our pupils to bring their own devices. May be that's the solution! We are advancing slowly but there is change". Along similar lines, Helena reports that the TAT training equipped her with the skills to troubleshoot and solve technical problems should they arise: "I would not worry if there is no internet connection. I have my mobile phone with which I can share the connection. I bring my computer and my students bring their own computers."

The participants are generally able to vary the use of teaching strategies and allow more learner-centred approach when assigning project work and collaborative tasks. Helena and Maya report intervening only when the pupils ask for help. The teachers mention suggesting to them online dictionaries, authoring and presentation software and collaborative spaces and leave learning to evolve in the process. They also require of them participation in discussion about the topics in the lesson, selection of materials to supplement the textbooks, and to download materials they can use for the class blog.

### 4.4 Commitment to "passing on" their skills to others:

Clearly, the participants conceived of the TATP as an opportunity to diffuse technology use in schools and showed commitment to passing on the skills they have learnt to their pupils and colleagues. Helena expected the TATP to have a snowball effect:

> *...Tech-age teachers must be active in their community and give a good example [and] pass their knowledge, not only to their students but to their colleagues and these colleagues pass them on to their students and so on.*

Other participants were rather disappointed to see that skills earned over a demanding nine-month in-service course were neither accompanied by incentives, nor promotion into the (even informal) role of "technology specialists". Hassan slammed the issue:

> *... I use technology, I do my best...I have these heavy bags with me all the time. Then what is the difference between me and someone who never does anything? Of course, there is gratification. My students love it and we laugh about the clips we make but in the end what's the difference?*

Based on the teachers' accounts, informal discussions with them, inferences upon examination of their Facebook pages, it is clear that they are lifelong learners wanting to sustain their professional learning as technology-using teachers. They have joined professional groups on social media, been taking courses online (e.g., e-teacher program), participating in national competitions (e.g.: Innovative Teacher Competition), and giving workshops at local and national conferences. Hassan mentions taking an online course as part of "*The English Online*

*Village*" and is searching for MOOCs and anything that is free (he is unable to pay for online courses from Tunisia) and holds ambitions beyond the confines of the classroom: "I want to have my own publications. I want to produce my own books, etc. I'm dreaming. I will never stop dreaming!" Helena is pursuing a Master's degree in educational technology and has won the "innovative teacher award". On the other hand, the fear of losing the skills they have learnt is looming over Maya who says: "the solution is to practice and practice using the software". When prompted, Ramy admitted that the latest Microsoft training he had attended did not teach him anything he did not know before. The question one is tempted to ask IREX, CNIPRE, The Ministry of Education and the local districts is "what was the plan beyond the TATP?"

## 5. Conclusion

Despite the limitations on triangulation in this study and the inability to observe the teachers, the results reported above can be of great relevance to researchers interested in teacher learning and teacher cognition. A study based on self-reporting data and reflections on experience reveals only one side of the story but can be informative for teacher educators, policy makers and international development funding bodies. The analysis above indicates that the impact of TATP on these teachers may still be unfolding. As Robb (2006, p. 343) put it, "The completion of any course or workshop is only a first step towards proficient use of the software, techniques or approaches studied". To apply technology in a low-technology context, they have to be self-reliant and restricted to what is doable under the circumstances. This study has the limitation of the researcher being unable to observe the teachers. Had this been possible, more concrete and tangible examples of the teachers' technology integration would have emerged. Self-reporting provides some indication of their thinking processes, strategies and aspired for actions. They did explain that they felt "transformed" as professionals after the TAT experience and gave examples of what they used to do with technology before it but corroboration would have provided firmer evidence of these teachers' transition process.

## 6. Suggestions and recommendations

Knowing that the TATP has ended, sustaining the teachers' interest in technology learning and in exemplifying technology-rich teaching practices is an important goal to be pursued by the professional community as a whole. TATP recipients from all disciplines can consider launching a portal which will be a virtual learning space with links to web pages, blogs, wiki, or FB pages of individual teachers or classes. The space can be used for sharing ideas in the form of video-taped demonstrations, lectures, software reviews and so on. In my view, a step forward for the teachers who took part in the TATP would be to harness the power of social networks themselves and connect their schools and classrooms with other schools and classrooms in Tunisia and beyond. They can also envision engaging pupils in different Tunisian schools in semester-long joint collaborative projects. As technology-capable teachers, they can take on leadership roles, coach and support colleagues and pupils online and, perhaps, hold annual or semi-annual face-to-face events for further bonding.

On a final note, I call for Tunisian authorities and funders of international projects to invest in training teachers in technology integration. The TATP finalists can be called upon to assist and receive further training in material development, mentoring and enquiry. As the Tunisian context is under-researched in the area of technology use in education, there is need for large scale surveys of all stakeholders of the type undertaken by Becker (2001), Teo (2011), or action research projects of the type carried out by Tai (2015), Messina and Tabone (2012), and Chao (2015). Research activity on technology use should be embedded in any further teacher training project to help document and disseminate local knowledge about teaching with technology. More importantly, as technology is not going to go away, it would make sense to rally forces to turn around the low-technology situation in our schools.

## Appendix 1: A Reconstituted summary of the Tech Age Course (2015 session) from official documentation

| | Timeline | Focus of the training |
|---|---|---|
| PHASE 1 | 40 hours over 5 weeks (March-May 2015) | Computer basics, interpersonal communication, cloud computing, advanced presentation skills |
| PHASE 2 | 40 hours over 5 weeks (July-August) | Creation of data, photography, audio, video, games, interactive CDRoms, blogs, web writing (html and CSS) |

| | Timeline | Focus of the training |
|---|---|---|
| PHASE 3 | 80 hours over 2 weeks (September) | Communication networks and advanced technology skills, leadership skills, project writing, communication skills and persuasion techniques. In addition, group will make field trips to sites in connection with educational technology. |

## Appendix 2: Questionnaire

University of Manouba
Faculty of Letters, Arts and Humanities, Manouba
Researcher: Faiza Derbel, Assistant Professor of English
2015-2016

| |
|---|
| Dear colleague<br>This is a short questionnaire to complete information about your experience as a technology-using teacher in Tunisia. I assure you that all information will be confidential and only used for research purposes. Appreciate your prompt reply. |

**SECTION1: Biographical data**
Name: (will be replaced by a pseudonym)
Last degree (or completed modules):
Age: __ 25-35 ___ 36-45 ___ 46-56
Number of years of experience:
Current school:
Previous school(s):
Level you teach right now:
What levels of English have you taught so far?
**SECTION 2: Educational Experience**
Have you ever taken an *Informatics* course at school?
Have you been involved in any training, either privately or provided by the Ministry, in the use of technology for teaching before the TAT experience? ____ Yes ___ No
If yes, provide details about focus and content:
Apart from TAT, what teacher development opportunities did you find available either online or face-to-face after TAT?
**SECTION 3: School situation**
Please indicate what facilities and what equipment are made available to you:
**SECTION 4: Practice**
What technology devices, tools or programs are you able to use under the circumstances above?
Which free software and/or resources do you use regularly with your students? What activities and how often are you able to do that?
What do you ask the pupils to do out-of-class that involves use of technology and the internet?
What type of guidance do you provide for out-of-class activities? What type of performance do you require?
What type of materials do you download yourself to take to class?
How different are the resources you bring from the ones you ask the students to look up?
What can be your personal objectives be for setting targets for your students' performance with technology integration?
What do you do to keep up your technology skills?

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# Knowledge Management Methods in Online Course Development

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**Abstract:** From the very beginning, the evolvement of knowledge management has been closely associated with e-learning. E-learning is one of the instruments of knowledge management widely used by companies and universities for knowledge dissemination. In the system of university management, knowledge management methods are used to address objectives of innovative development. The pinnacle of knowledge management is the support of innovative efforts of teachers and researchers. In a university, such efforts embody the development of online courses that is essentially the creation of an innovative product, where the end product, an online course, represents the scientific and methodological solutions. The e-learning technologies and methods have become for a long time an everyday tool used to support the educational process in top-ranked universities. The scientific novelty of the project is the generation of a knowledge management methodology for the development of inter-university online courses. Teacher community faces a paradoxical situation where many universities are willing to support global free access to their educational materials by means of OER and MOOCs platforms. However, the development of inter-university online courses is, in most cases, the initiative of a team of teachers. The paper considers knowledge management levels for thee-learning course development.

**Keywords:** e-course development, knowledge management, open resource, e-learning collaboration

## 1. Introduction

Knowledge management (KM) is usually associated with five levels of knowledge creation. From the very beginning, educational community focused on knowledge creation at personal level, while the team level appeared historically along with the work of teachers and researchers in departments and faculties. However, with the advancement of KM and information technologies, it became possible to organize work with knowledge at new levels with a growing number of involved specialists, namely, at the university, inter-university, and global levels.

Universities in many countries have defined their policies in the field of KM for supporting their strategic goals (Trivella et al, 2015). We see striking examples in the United States, South Korea, and Japan. The university information environment provides the necessary services, including e-learning and access to electronic libraries to support the educational and research activities. KM methods not only enable sharing of knowledge accumulated by the international community and disseminating thereof in the form of educational products, but also help incentivize the development of new innovative products and engage all levels of staff in the innovative efforts. The important elements of KM are the tools for joint accumulation, use, and creation of knowledge. These tools differ from the traditional means of individual work with information.

KM approaches are currently actively used to advance e-learning, in particular for the development of online courses (Kasapbasi, 2014). Some papers deal with the management of academic knowledge (Tikhomirova et al, 2011). Indeed, the contents of both the knowledge and work with the knowledge in administrative tasks will differ significantly from those in tasks that address learning or development objectives. Typically, the creation of an online course relies upon the global state of the knowledge associated with the course subject matter rather than on the achievements of a specific university, and the author team often incorporates experts from multiple universities.

Academic practice has accumulated positive experiences and identified best practices of knowledge management at team, university, and global levels, while the inter-university level remains an exception. The ultimate goal of knowledge management is the development of an online course and the use of this course in the learning process. There arise no difficulties in building an inter-university team, as members of the teaching staff are usually highly motivated and mobile when it comes to gaining a new experience. The difficulties arise in meeting the requirements of various universities to the created courses and educational programs, for which the content is developed. Intellectual property rights to the resulting innovative product may also become the subject of fierce debates.

## 2. Research methodology

The research methodology is based on the guidelines for the creation of online courses for university educational programs, open education, and KM theories. The development of online courses attracts considerable attention of the academic community and corporate sector where online courses proved highly effective. However, high fundamental level of educational programs in universities implies heavy demands as to the content of courses and their structure. Aspects of online course development are considered in the context of pedagogical design. A strong focus is placed on the selection of tools for the development of individual components within the course structure and integration thereof with modern social media, customarily incorporated under the concept of smart learning (Tikhomirov, 2013). Active research in the field of smart learning was conducted by South Korean researchers (Jeong et al, 2013); the contribution of Russian authors (Urintsov et al, 2015) is also worth noting. The toolkit e-learning development includes both the special software and available online applications.

Higher education around the world performs important social and economic functions associated with building and strengthening the intellectual potential, the key resource for the advancement of an innovative economy. The theory of e-learning logically evolves into open education (Draghici et al, 2015). Open education and initiatives related to free access to educational services and high quality content have received support at the national level in many countries and in international organizations, such as UNESCO. Research and publications of the UNESCO Institute for Information Technologies in Education make significant contribution to the promotion of open education (UNESCO, 2016). Researchers around the world collaborate to explore issues associated with open educational resources and MOOCs (Nascimbeni et al, 2014). E-learning course development space expands from the individual to the global through international initiatives such as e-Mundus project. In KM theory, e-learning has become one of the instrumental methods of intra-organizational knowledge dissemination. At the same time, the KM system in universities creates conditions for the emergence of an effective online learning environment. In some universities, it has been possible to combine the KM system and the e-learning environment (Okamoto et al, 2009). KM theory serves to facilitate the progress of e-learning in the universities.

This research study is based on the theory of levels and dimensions in KM (Mentzas et al, 2003). According to the key concepts of the KM theory, the process of KM involves five dimensions, from individual to global.

## 3. Knowledge management in open education

The history of humankind shows that in the social development of a society, knowledge and universities have always been perceived as inseparable elements. The universities were places of knowledge creation and dissemination. With the economy shifting from the industrial to the informational phase, the universities have lost their monopoly on knowledge. Business generated the theory of knowledge management designed to secure the creation, preservation, and dissemination of the most valuable resource for companies - knowledge. With the advancement of KM theory, more and more practitioners (according to the example of IT corporations) and researchers agree that free dissemination of knowledge ensures a greater economic effect than restricted access does (McGreal et al, 2016). In particular, the academic community and universities have always been responsive to the idea of free access to knowledge and educational content. In the educational community, open educational resources were pioneered by the Massachusetts Institute of Technology (MIT) that started an open environment for online courses (open courseware) in 2001. Ten years later, platforms of massive open online courses were launched causing a great deal of attention in business and educational circles (The Economist, 2013). For accuracy, it should be noted that the first experience of a MOOC took place three years before at the University of Manitoba (Parry, 2010).

Mentzas et a, (2003) identified five dimensions and levels of knowledge dissemination, which are useful for representing the level of cooperation in the field of e-learning. Management moves from the individual level to the global level. KM at the team or organizational level is possible where the individual level is well developed. Each of the levels is characteristic of its own methods for the key KM functions: communication of knowledge, collaboration, KM, and creation of innovation. Fig. 1 represents five dimensions of KM in e-learning.

| | | | | |
|---|---|---|---|---|
| Global | Social Media | Wiki wikieducator.org/ | MOOCs OER | e-learning tools |
| Inter-university | Social Media | Web-portal | MOOCs OER | e-learning tools |
| University | Web-portal | LMS | LMS | e-learning tools |
| Team | e-mail | Office | Social Media | e-learning tools |
| Individual | e-mail | | | e-learning tools |
| | Communication | Collaboration | KM Process | Create& Innovate |

**Figure 1:** Five dimensions of knowledge management in e-learning

Let us consider these levels in more detail in the context of development of online courses.

## 3.1 Individual and team level

The basis for all subsequent KM levels is the management of individual knowledge. Production companies spend a great deal of effort on building a culture of KM at the individual level employing, in particular, additional training to motivate employees. The academic and creative environment of universities has been originally meant to facilitate management of individual knowledge. Universities do not require additional efforts for training of educators and researchers in methods of KM. Working with knowledge, and creation, accumulation, and dissemination of knowledge are the key processes in a university. However, additional training in work with specific tools of KM may be provided. The main advantage of university KM in terms of online course development is that shaping of the KM dimensions expands the opportunities for the use of key resources available to each individual participating in the innovation efforts. Each further level of KM increases the opportunities available to each participant of the online course development process. The resources and technologies available for the development of innovative products and services build up with each subsequent level (Fig.2).

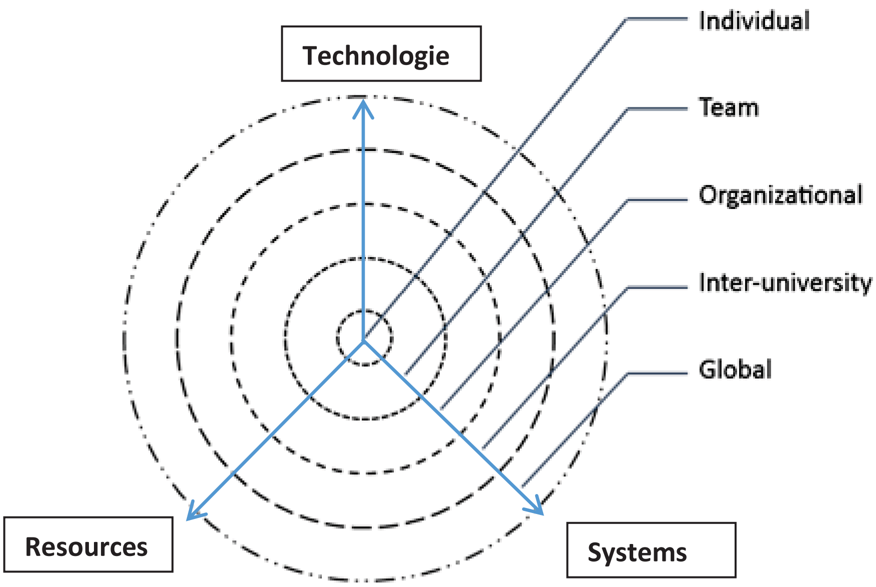


**Figure 2**: The allocation of resources across the five KM levels

KM at individual and team levels can go without administrative intermediation on the part of the university management and regulations.

### 3.2 University and inter-university level

The shaping of university-level KM begins with the framing of university policies and generation of regulations to clarify key concepts and objectives of KM. On the one hand, there is an expanded range of professionals involved in innovation efforts; on the other hand, these professionals can rather slow down the process of online course development. The formation of a common knowledge environment requires tools for ordering of this environment. The knowledge repository and the description of specific knowledge objects must be structured. A variety of approaches can be used to tackle this objective. The traditional approach is to build a KM system based on meta-data. Thus, in order to avoid turning the information environment of online course development in the information chaos, it requires strict rules.

Methods for creating innovations in a common information environment will require management tools for joint work of the author team. Creative alliances can emerge spontaneously from contacts at conferences, but the participants of such alliances should deliberately manage the development process.

At the university level, a system of KM is created, the main components of which are strategy, corporate culture, resources of information and knowledge, information infrastructure, and information technologies. The distribution of methods, tools, and resources is shown in Table 1.

**Table 1**: Methods, tools, and resources of knowledge management by level.

| KM level | KM methods | KM tools | KM resources |
|---|---|---|---|
| **Individual Level** | Search, collection, and storage of knowledge | Application software package | Individual resources |
| **Team level** | Dissemination and collective use of knowledge | Cloud services for remote work | Team resources |
| **University level** | Creation of innovative courses and services | Corporate portal | University resources |
| **Inter-university level** | Open access to knowledge | Inter-university networks and services (Web 2.0) | Resources of the university consortium |
| **Global level** | Open/free access to knowledge | Platforms for creation of open online courses and educational materials | Open and free resources |

New communication technologies lead to the onset of a world where there are practically no barriers for the creation, exchange, and dissemination of knowledge. The process is mainly associated with the development of the Internet and new technologies such as web 2.0 that reduce the time gaps between knowledge creation and knowledge implementation in innovations (Kulakli et al, 2014). Modern information and communication technologies (ICT) form a basis for creation of a common information space, which comprises databases of business and scientific information, as well as communities of professionals and consumers and ensures free knowledge dissemination.

### 3.3 Global level

In the span of a few years, there arrived a number of innovations in education and online platforms for e-learning, but their successful combination and implementation in the Coursera platform has led to a fundamentally new approach to online course development. MOOCs platforms are designed to train simultaneously an almost unlimited number of online course learners. Thus, the MOOCs' audience becomes limitless. The Coursera platform and other MOOCs platforms allow users around the world to engage in online courses from leading teachers and universities, as well as to join in lifelong education with minimal costs. Most universities around the world endeavor to be able to place their courses on leading MOOCs platforms. One of the founders of MIT OCW, Professor Steven Lerman stressed "Selling content for profit, or trying in some ways to commercialize one of the core intellectual activities of the university, seemed less attractive to people at a deep level than finding ways to disseminate it as broadly as possible.'' (Golberg 2001).

Universities willingly join their efforts in creating initiatives to support open education at the global level. An example of an international initiative is the eMundus project bringing together participants from nine countries and established to enhance international cooperation in higher education through open education. Open education comprises open educational resources, massive open online courses (MOOCs), and virtual mobility. The project pays special attention to virtual mobility as a form of international cooperation in teaching by means of ICT aimed at the formation of the educational environment that allows students to learn together regardless of their occupation or country of residence.

At present, it can be argued that at the global level there exists free storage and dissemination of knowledge. However, the effectiveness of shared use of global knowledge may be limited due to the lack of knowledge systematization. Most of those aware and unaware of e-learning can name platforms with open educational materials and courses; however, the search for courses and within the courses causes difficulties. The Coursera platform provides about 2,000 courses; search of the courses is organized in subject catalog by course name or by name of its developer. Search by course content is not available.

Despite their huge contribution to the development of the international educational environment, MOOCs are not devoid of controversial results. They include, in particular, low involvement of students in the course study, limited opportunities for getting credit points following the learning, limited technologies in learning. These problems can be removed by designing courses for specific educational programs of universities.

## 4. Inter-university course development

At the university level, as well as at the global level, methods of knowledge management get strong support. However, the inter-university level faces significant contradictions that impede the development of online courses. These obstacles are the differences in requirements to online courses and educational programs and the number of credit points assigned for the courses. The issues of e-learning information security also require consideration in the process of course development (Pyatkov and Zolotarev, 2013). University management often ignores the opportunities of cooperation with other universities in developing the educational content. The basis for such cooperation is provided by independent organizations, for example, for Russian universities, the Vladimir Potanin Foundation.

To test the inter-university knowledge management methods, an online course “Business resources on the Internet” is being developed (Where? By whom?) as part of a master’s educational program. The purpose of developing the online course “Business resources on the Internet” is to create conditions for a successful course study by using online components (forum, webinars, online learning content) and innovative methods of teaching in an electronic environment (gamification, the formation of knowledge networks, adaptive educational content), as well as by increasing the course availability through its implementation directly in the Internet environment. The Internet is becoming an integral part of professional space, the efficient operation in which depends not on technical computer or telecommunication networks skills, but rather on the understanding of processes of formation, storage, dissemination, and search of information and the person’s terms of reference within the organization. The relevance of the course is associated with the increasing impact of Internet information resources on the companies’ performance and individual business processes. Today, the ability to produce, search, analyze, categorize, summarize, recognize, process, and provide information and make decisions directly affects the quality of life of individuals and society.

The development of the online course “Business resources on the Internet” brings together a team of lecturers from leading Russian universities, including Lomonosov Moscow State University, Plekhanov Russian University of Economics, Financial University under the Government of the Russian Federation, and National Research Irkutsk State Technical University. Developing of a course with the active participation of teaching staff from multiple universities will fill the course with quality content and ensure its wide dissemination and promotion in the educational environment. This course will be interesting for students to study and for other teachers to use.

The course developers identified three groups of tasks associated with the methodological support of an online course, the course development, and training with the use of the online course (Table 2).

**Table 2**: Three groups of tasks for e-course development

| Group of tasks | Tasks |
|---|---|
| **The first group** of tasks associated with the methodological support | Actualization of learning content for the development of the distance learning course.<br>Adjustment of the course content to the requirements and possibilities of distance education technologies.<br>Designing models for visualization of learning content in the dynamic element of the course.<br>Designing a flexible model for management of students’ knowledge based on the organic relationship of static and dynamic elements of the project. |

| Group of tasks | Tasks |
|---|---|
| | Designing models of academic performance monitoring for the dynamic element of the course. Development of practical tasks. Development of tests and examination tasks. Discussion and review of the course learning content in the professional community. |
| **The second group** of tasks associated with the development of the course | The development of a scenario of the distance learning course using the concepts of pedagogical design and based on the competencies that should be taught to the student in the process of studying the distance learning course. The implementation of the models of learning content visualization and academic performance monitoring. The development of the required online components of the distance learning course. Preparation of video lectures on the course topics. Assembly of the course in the e-learning environment. Testing of the course, identification of criticism, and collection of observations. Adjustment of course materials and completion of the distance learning course development. Discussion and review of the distance learning course in the professional community. |
| **The third group** of tasks associated with teaching based on the course | Placement of the distance course in online environment or on a specially created web site. Formation of study groups for studying the distance learning course. Holding of webinars on the course topics and practical assignments. Organization of course discussions (forums). Learning and teaching support for students and teachers. Analysis of the online course effectiveness by questioning and interviewing students and teachers. |

Methodological novelty of the project is the evolution of methods for the use of e-learning technologies in the organization of online, team, and practical activities of students in the e-learning environment for Russian universities. Methodological novelty of the project is also associated with the solution of a new methodological problem that consists in the need for modification of the system and methods of representing learning content in accordance with the changes in the information technology and e-learning environments. Currently, education does not fully utilize the potential of modern information technologies and Internet services. In order to utilize the potential of these technologies, it is necessary to develop new teaching methods for online courses using learning games, social-networking technologies for knowledge transfer, and networking of teachers.

The methodology of the “Business resources on the Internet” course development is based on three main groups of research methods: pedagogical methods, KM methods, and information-and-communication methods. The pedagogical methods involve the use of such methods as pedagogical experiment, observation, and collective behavior research techniques (questioning, etc.). Methods of KM are based on various organizational approaches to shaping the educational environment and students’ motivation for achieving better results. The information-and-communication methods and approaches are based on the methods and principles of designing information-and-communication systems, including system analysis and the development of metadata structures.

## 5. Summary

Innovation is an integral element of strategic management in modern universities. An online course designed in a university is, fundamentally, an innovation, a practical application of research results and methodological solutions of the authors. The online course as an innovative product and the innovative training services that are provided using the online course are a short way for the commercialization of scientific and pedagogical skills of the authors.

KM assumes great importance in the development of online courses as part of master’s programs, as the courses under master’s programs are more specialized and generally produced and delivered by a single author. KM methods can significantly enhance the support of university and inter-university initiatives.

In the development of online courses, KM methods make it possible to use accumulated knowledge, form author teams, and support the joint project activities of teachers and students in a more efficient way. The outlined university policy for cooperation with other universities facilitates the understanding of the processes associated with joint development and use of knowledge by all participants.

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# Repurposing the Learning Environment: Using Robots to Engage and Support Students in Collaborative Learning Through Assessment Design

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**Abstract:** This paper outlines the setting up and the implementation of a multi-mode blended learning environment driven by an assessment design. The technological blend comprised access to robots and an online group space. The pedagogical blend included the assessment design and teaching and learning practice informed by current research taking place in the School of Computer Science at the University of Hertfordshire. Learners were provided with access to the research centre and the robotics house to help progress and complete the group based assessment and supplemented by class-based learning. The overall aim was to repurpose the learning environment and shift the emphasis from teacher-centric to learner-centric practices in order to motivate and engage learners in authentic group based assessment. Additionally, prominence was placed on learners sharing work on their assessment as it progressed using a mini-project approach. This constructively aligned with the assessment and the subject delivery. In this learner-centric environment learners alongside the teacher administered feedback to students on their work as it progressed. This was intended to provide an opportunity for learners to develop their understanding and skills and take the necessary corrective action. Learner attitude was captured quantitatively by means of a questionnaire. Qualitative data was obtained using learners own reflections of their experience authored by students when explaining their answers to questions posed on the questionnaire. Overall learning was measured using the learner's performance on the assessment. There are some interesting findings including learner views on the assessment design, how access to the robots and the research centre supported their learning and the learners overall perceptions of learning in the multi-modal blended learning environment. These findings will add to the debate on how we engage with and support learners who are growing up in a digital world and provides an example of how we can do this by taking a research informed teaching approach to the practice of learning driven by an assessment design using robots.

**Keywords**: robots, research-informed-teaching, research-led-learning, collaborative learning, assessment, human- robotic-interaction

## 1. Introduction

The University of Hertfordshire (UH) recognises the importance of Research Informed Teaching as noted in the strategic plan ((UH strategy, 2015). There is a similar picture nationally emphasising the importance of research in underpinning curriculum provision. Between 2006 and 2010 Plymouth University developed a large scale project to link research and teaching activities and its importance is reinforced in the university's strategic plan (UOP, strategy 2020).Bournemouth University have coined the phrase "fusion" to highlight the synergy between research, education and professional practice (BU strategy, 2012). The University of Lancashire has developed a centre specifically devoted to Research Informed Teaching further emphasising its importance nationally in the student learning experience.

This paper will present an example of the practice of Research Informed Teaching at the University of Hertfordshire by outlining a module designed to embed research related to robots linked to teaching and learning driven by the assessment design. Learners were provided with access to the adaptive research group http://adapsys.stca.herts.ac.uk/ and the robots via the School of Computer Science Research Centre and in scheduled classes. In this study, we were particularly interested in supporting learners studying a Human Computer Interaction module in the completion of their group based assessment to design a user interface for the robots. Part of this process was to progressively encourage learners to become active enquirers and researchers which was necessary to solve problems for assessment completion. The intention also was to inspire learners to collaboratively develop their work based on authentic research processes within the field of Human Computer Interaction and Human Robotic Interaction in the discipline of Computer Science. Hence, provide opportunities for master students studying the Human Computer Interaction module to access current research and encourage and support the nexus between research and teaching within the University of Hertfordshire.

The use of research informed teaching in this context involves a paradigm shift in university teaching where the emphasis is placed on students to socially interact and actively engage in their own learning. Doolan (2013a;

2013b; 2015) describes this social paradigm in the form of the dialogic *shamrock* and views the social and cultural context of learning as crucial and a central tenet of learning itself. It is argued that designs for learning that encourage participation, reciprocity, dialogue and mutual engagements whilst learners are engaged in an active learning experience, knowledge is socially constructed and skills are developed. In this context the teacher role shifts to one of facilitator and orchestrates learning. In this study this took place through repurposing the learning environment to engage learners in learning through authentic group based assessment in and out of the classroom. Beyond the class based environment learners had access to a group space housed on the institutional managed learning environment intended to support their group based learning, in addition to access to the research undertaken by the adaptive research group, with a specific focus on robots both Human-Robot-Interaction and Human-Computer-Interaction.

Human-Robot-Interaction (HRI) is defined as "a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans. Interaction, by definition, requires communication between robots and humans" (Goodrich, 2007:204).

Human-Computer-Interaction (HCI) is defined as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewitt et al. 2014:5).

## 2. The practice

The practice reported in this paper took place on a Human Computer Interaction module; an elective chosen by postgraduate learners studying a Masters in Computer Science. The students undertaking this are predominately from overseas. The primary motive is to provide an insight into the concepts, tools, techniques, standards and guidelines needed to evaluate and build interactive systems. Learners undertook practical application, evaluation and designed a user interface for one of the robots under study by the adaptive research group. The module and assessment completion was over one semester. There was one group based assessment which was supported by a series of mini-projects and a private group space housed on the institutional managed learning environment and intended to be used as a resource to support the group based assessment. Indeed, its use was necessitated by the fact that learners were required to upload their mini-projects to share in class to obtain feedback on their learning.

The assessment specification was designed to align with the topics delivered on a weekly basis in the lectures, delivered to learners in the first week of the semester and due for submission at the end of the semester. The serious of mini-projects were designed to align with the assignment specification. The learning activities within the assessment were a mix of individual and group tasks as outlined below and designed to be authentic based on learner engagement with research and access to the research centre, research group and the robots. At the same time, the assessment was designed to promote reciprocity, dialogue, participation and mutual engagement within and between groups. Within groups this was made possible by designing the activities to be divisible between learners and require interdependence. Across groups of learners the mini-project approach necessitated specific components of the assessment be showcased as work progressed to peers in class to obtain feedback for the tutor and peers alike.

23 learners studied the module and were given the opportunity to work in groups of 3 or 4 allocated by the teacher. The assignment specification comprised a mix of individual and group tasks, the basic features of robots and tasks are described below. Student teams were expected to choose ONE of these and add to the basic functionality based on their own research findings. The overall task was to develop a web based interface to interact with the robot chosen by learners. This necessitated the need for learners to access the robots to help ascertain further requirements, to analyse and evaluate in order to design a user interface to be used by a non-technical person. Learners were required to perform and report suitable user and usage modeling and task analysis. They were not required to program their designs rather a prototype of usable interfaces using storyboards and screenshots and/or sketched drawings of representative and relevant screens clearly explained was expected. The following provides a brief overview of the robots and possible tasks to be chosen by the students:

### 2.1 Care-O-Bot

A general purpose domestic service robot Care-O-Bot (Website, 2016) has been developed to do a number of useful tasks around the home (Reiser et al. 2013). The robot has a carrying tray fitted, a chest mounted touch sensitive display, speech synthesis available (but not recognition) and could be fitted with a simple expressive head or indicator lights if required. The main tasks it can perform include: general fetching and carrying, following a user, reminding, vacuum cleaning, opening doors, greeting visitors and showing them in (if recognised), greeting delivery people and carrying letters and packages and packages to the user. The robot also has the capability to learn from previous tasks and schedules, so will also make suggestions for tasks at appropriate times.

*Task* - The robot is WIFi/www enabled, so a web-based interface is required which would be useful for the user to control the robot if it is not present in the room. The web-based user interface should allow regular users/house occupants to control the robot in a natural and user friendly way.

### 2.2 KASPAR

KASPAR is a small child-sized robot used primarily for providing therapy for children with autism (Dautenhahn et al. 2009). A new model has recently been developed for use by non-robotics specialists including therapist and teachers.

*Task* - The robot is primarily controlled over WiFi and it is proposed that a suitable web-based user interface is to be developed. The interface is to be accessed through a standard browser and should be usable from a wide range of browser equipped devices (PCs, tablets, mobiles etc.). The functionality of the interface should allow the user to control the position of each of KASPARs actuators individually: eyes (up/down, left/right), eyelids (up/down), waist (left/right), right and left shoulders (forward/back, up/down), elbows (up/down) and wrists (twist right/left). KASPAR can also speak and play music. Sets of actuator (joint motor) positions should be able to be learned (stored) as "poses" and learned poses and sounds can then be "played back" in a defined order together to form extended action "sequences".

### 2.3 Baxter

The Baxter robot (Baxter Website, 2016) is a light industrial stationary robot which has two compliant manipulator arms. Unlike most other industrial robots, the compliant actuators, and advanced software and control allows it to be used safely in the presence of humans. It is designed to perform various pick and place tasks; either autonomously, or co-operatively with, and in close proximity to human co-workers.

*Task* - A new board game playing system is being developed and has been prototyped using the Baxter robot. Currently it can play Draughts (Checkers) and Chess on the same board (different pieces). The robot has a manipulator (arm) which is used to make moves on a physical board, with the human opponent(s) either making their own move, or the robot can sense the current board positions and configuration by means of a camera/vision system. The robot has a small (10") touch screen display mounted on its chest. The robot can play by itself autonomously, or alternatively there could be a remote human controlling the robot through a web-based interface. A web-based user interface for the remote human player is required, which incorporates the capability for the local and remote human players to both play the game, and also interact socially while doing so.

### 2.4 Charly

CHARLY (Companion Humanoid Autonomous Robot for Living with You) is a robot that can be used (among other tasks) as an "avatar" to provide a remote user with a physical presence at an office location which located many miles away from the users actual location (Walters et al. 2012). The underlying technology has been developed and the following capabilities are currently available by typing in commands at a console:

- Ability to autonomously navigate safely around a remote office building location. Each known room or location has a name and it is sufficient to provide the name of a place to navigate to. The robot can move safely by itself from room to room, avoiding obstacles and people. It can also send a map image, with its location marked, to the user via an internet connection.

- Can also be moved by the remote user by direct user control. However, pre-emptive collision avoidance behaviour will still be active, so it will not be possible for the user to make the robot collide with people or objects, or to drive down stairs etc.
- A head-mounted wide angle camera is fitted so a streaming video of the robot's immediate environment can also be sent to the remote user via the internet connection. The direction (pan and tilt) of this camera can also be controlled by the remote user.
- A head display is fitted, where a remote user's face can be projected onto (via Skype or Webcam). It also has a microphone and loud speaker so that the remote user can participate in conversations with other people at the office location.
- The robot has a number of pre-defined gestures (pointing, waving, etc.) which can be called up by typing the name of the gesture to be performed.

*Task* - A web based user-interface was now required which would allow any non-technical remote user to control Charly in order to move it around an office building to named locations, interact with other people using sound, video and gestures. Also to allow the user to take (limited) direct control over Charly, as indicated above.

In addition to the development of the human-robot interface by learners, they were required to underpin their work by suitable scholarly research, to make informed and critical choices amongst their research findings, in order to help justify and explain their approach to the robotic interface design.

## 3. The study findings and discussion

Quantitative and Qualitative data was obtained from a post module questionnaire. Twenty out of a possible twenty three learners completed the questionnaire, which was undertaken in order to measure learners' attitudes and the impact of the teacher role. The Questionnaire comprised eight questions, with question 8 in six parts (a to f) and space for open ended comments. Table 1 below provides short details of the questions asked.

The learner responses were provided using Likert scales (Likert, 1932) and each participant rated each question as 5 = "Agree Very" to 1 = "Not Very". Table 1 indicates the Mean, Standard Deviation, Median and Mode average values for the learners for each question. The Mode (N) values are the number of responders' who selected the Mode (most popular) value for each question. The mean, median and mode values are in close agreement, which indicates that the distribution of the responses was relatively normal, given the small sample size, though skewed towards moderate "Agree" with regard to the respective questions. This also may be indicative of "confirmation bias" effect being present in that all positive answers required a high rating and negative responses a low rating.

It can be seen in table 2 that Q2 had the lowest mean rating (3.4), and also one of the highest Mode (N), indicating that 8 of the 20 learners rated Robot Access as relatively poor. The chart in Figure 1 Illustrates the relationship between the mode, median and Mode (N) values for each question more clearly.

The qualitative data provides some insight into student dissatisfaction with access to the robots. A learner stated *"Can't take pictures with it"* [sic] and two learners commented that they did not have enough access. This may be due to student absenteeism or a need for the teacher to revisit the information provided to learners. Two of the robots, KASPAR and Care-O-Bot, were housed in the Adaptive Systems research group labs with access by special appointment. These robots were also being used continually by postgraduate students and researchers for their current work, so both these factors probably affected the availability of these robots for access by students.

Positive comments included "*Access to the robots in the robotic laboratory supported my study greatly as it let me have hands on practical experience in robotics"* [sic] and "*It helped me to be more clear and understand how to design"* [sic].

This was deemed a positive outcome especially given 12 out of the 20 learners stated that access to the robots supported their learning. The emphasis on research informed teaching via access to robots to help learners study, analyse and evaluate in order to capture, clarify and validate the requirements to develop the human robotic interface and complete the group based assessment was paramount. The intention was to provide learners were with access to the research centre and the robotics laboratory to help progress and complete the group based. As explained in the introduction, in this study, we were particularly interested in supporting learners studying a Human Computer Interaction module in the completion of their group based assessment to design a user interface for the robots.

Related to Q.5 in table 1. 16 out of the 20 leaners agreed or strongly agreed with the statement "Using Robots was a novel approach to teaching" reasons provided included:

> *"I totally agree that using robots was one of the best things we have experienced by this module" [sic].*
>
> *"I really enjoyed the teaching, the teachers made everything very interesting, using the robots was exciting and helped develop the interface" [sic].*
>
> *A learner comments related to Q6 included "Looking at the robots and understanding what it does and how it does it, was the turning point for me to do this module" [sic].*

The learning design was intended to progressively encourage learners to become active enquirers and researchers which was necessary to solve problems for assessment completion. The intention also was to inspire learners to collaboratively develop their work based on authentic research processes within the field of Human Computer Interaction and Human Robotic Interaction in the discipline of Computer Science. Hence, provide opportunities for master students studying the Human Computer Interaction module to access current research to motivate, encourage and support the nexus between research and teaching.

> *Relating to Q8a a learner comments "Mini Projects helped me to go that extra way to the main project" [sic].*
>
> *Q8b "Assessment feedback was the best way to improve my weakness" [sic].*
>
> *Q8c a learner comments "By looking at other students work presentation help me understand" [sic].*
>
> *Q8d "Working with a group was the best idea. Learned a lot" [sic].*
>
> *Q9e "Individual task was challenging and intellectually stimulating" [sic]*
>
> *Q8f "Group task was very tough, it made me learn how to tackle a problem with a team" [sic].*

The group based assessment was designed to specifically place the students at the centre of their learning, to empower them to work productively as a group and progressively using a mini-project approach which required groups of learners to present their work to their peers as it progressed in the class based learning environment. Emphasis was placed on students to socially interact and actively engage in their own learning. The authentic learning design embedded an assessment for learning approach which encouraged learner participation in giving and receiving feedback on their work as it progressed, reciprocal learning was key, dialogue and stimulating learners through authentic learning tasks was also key as was access to cutting edge research being undertaken in the adaptive research group related to human robotic and human computer interaction appears. These appear to have challenged and engaged learners.

**Table 1**: Overall question averages for all participants (Agree: 5= Very Much, 1=Not Very

| Q_Num | Question | Mean | Std Dev | Median | Mode | Mode(N) |
|---|---|---|---|---|---|---|
| Q1 | Robot it motivated me? | 3.9 | 0.8 | 4 | 4 | 11 |
| Q2 | Robot access supported me? | 3.4 | 1.1 | 3 | 3 | 9 |
| Q3 | Research Centre access supported learning | 3.8 | 1.2 | 4 | 4 | 8 |
| Q4 | Module informed by research? | 3.9 | 1.1 | 4 | 5 | 7 |
| Q5 | Robots novel for teaching? | 4.0 | 1.1 | 4 | 4 | 8 |
| Q6 | Robots kept me interested? | 3.8 | 1.2 | 4 | 5 | 7 |
| Q7 | Learned a lot on this module? | 3.7 | 1.2 | 4 | 4 | 6 |
| Q8a | Seeing other students work useful? | 3.8 | 1.1 | 4 | 4 | 7 |
| Q8b | Tutor assessment feedback useful? | 4.0 | 1.1 | 4 | 5 | 8 |
| Q8c | Other students' assessment feedback useful? | 3.8 | 1.0 | 4 | 4 | 8 |
| Q8d | Working in a group? | 4.0 | 0.9 | 4 | 4 | 12 |

| Q_Num | Question | Mean | Std Dev | Median | Mode | Mode(N) |
|---|---|---|---|---|---|---|
| Q8e | Individual tasks useful? | 3.7 | 1.2 | 4 | 4 | 7 |
| Q8f | Group tasks useful? | 3.8 | 1.2 | 4 | 4 | 8 |
| | **Overall Means:** | **3.8** | **1.1** | **4** | **4** | **8** |

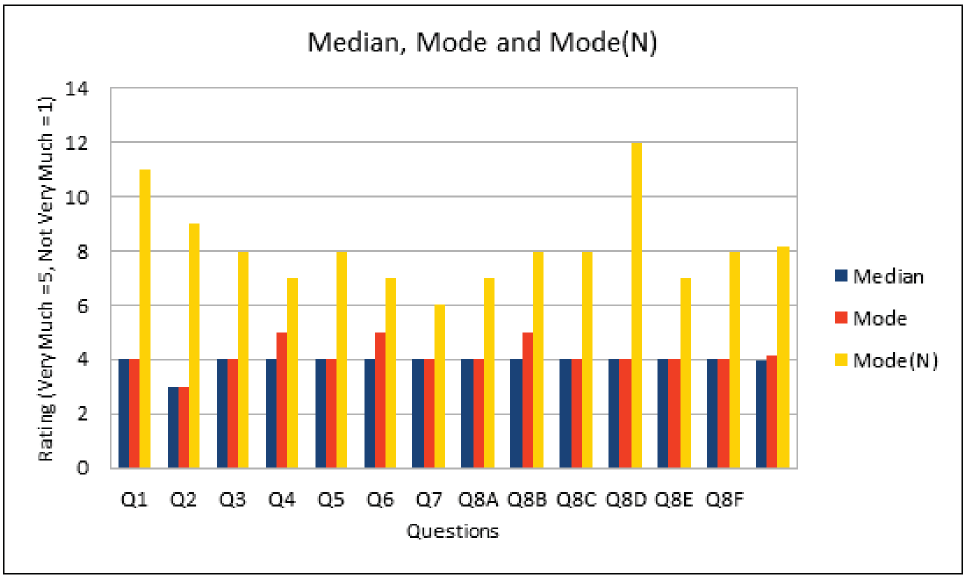


**Figure 1:** Median, mode and mode frequencies for question responses 1 to 8(f). Note

Paired T-tests (generally considered acceptable for ordinal ranked data sets) and Wilcoxon Signed Rank tests (stricter test for ordinal ranked data sets) both indicated that there were no statistically significant differences for individual students regarding their responses to the eight questions, so it can be surmised that as a group they were relatively homogenous. This was reinforced by the results from a series of between question, paired Pearson R Correlation tests which found a number of significant correlation effects between question responses for the group as a whole. See Table 2 for the Pearson R test results, with strong correlations effects highlighted in bold. Note, usually an R value of over 0.35 indicates a relatively strong correlation. It can be seen that there were strong correlations between participants' responses in particular for Q1 and Q2. Those who reported that the Robotics Project was motivating, also found that Access to the Robots supported their work, and also conversely that lack of access hindered their work. This supports the remarks made by some students in the Qualitative Evaluation that some had found difficulty in accessing the robots. Other correlations to note were between:

- Q3 and Q8(a to f): Students who rated the Research centre access useful, also found Tutor and Student Feedback, group working and individual set tasks useful
- Responses for Q4, Q5, Q6 and Q7 were all positively correlated with each other. In particular Q4 (Module informed by research) was correlated positively with rating (Q5) Robots Novel, (Q6) Interesting, and (Q7) Learning a lot on the module.
- The student responses to Q8 (a to f) were all positively correlated, indicating students generally found group-work, combined with teacher and fellow student feedback was useful.

**Table 2**: Pearson R correlations: Pairwise for individual participant's question responses

Learning was measured using the learner's performance on the assessment. The full range of marks were obtained by learners with the maximum mark of 83 and the minimum of 39. The pass conditions for the module were pass the assessment overall at >=50 marks.

| Question | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8a | Q8b | Q8c | Q8d | Q8e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q1** | 1 | | | | | | | | | | | |
| **Q2** | **0.597** | 1.000 | | | | | | | | | | |
| **Q3** | **0.485** | **0.588** | 1.000 | | | | | | | | | |

| Question | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8a | Q8b | Q8c | Q8d | Q8e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Q4** | **0.629** | **0.600** | 0.200 | 1.000 | | | | | | | | |
| **Q5** | **0.480** | **0.498** | 0.144 | **0.710** | 1.000 | | | | | | | |
| **Q6** | **0.731** | **0.651** | 0.195 | **0.780** | **0.657** | 1.000 | | | | | | |
| **Q7** | **0.591** | **0.712** | 0.186 | **0.674** | **0.477** | **0.771** | 1.000 | | | | | |
| **Q8A** | **0.399** | 0.243 | **0.402** | **0.352** | 0.121 | 0.091 | -0.008 | 1.000 | | | | |
| **Q8B** | **0.602** | **0.411** | **0.573** | 0.204 | 0.129 | **0.366** | 0.273 | **0.425** | 1.000 | | | |
| **Q8C** | **0.463** | **0.535** | **0.516** | **0.360** | 0.242 | 0.346 | 0.367 | **0.761** | **0.544** | 1.000 | | |
| **Q8D** | **0.655** | **0.419** | **0.535** | **0.303** | 0.209 | **0.498** | **0.586** | **0.363** | **0.626** | **0.603** | 1.000 | |
| **Q8E** | **0.364** | **0.426** | **0.541** | **0.398** | 0.151 | 0.226 | 0.237 | **0.722** | **0.599** | **0.744** | **0.488** | 1.000 |
| **Q8F** | **0.557** | **0.484** | **0.799** | 0.137 | 0.116 | 0.325 | 0.342 | **0.380** | **0.782** | **0.634** | **0.847** | **0.576** |
| | | | | | | | | | | | | |
| | | **Note: anything above 0.350 is considered significant (Bold)** | | | | | | | | | | |

## 4. Conclusion

In this study repurposing the learning environment to engage learners in learning through authentic group based assessment in and out of the classroom resulted in a positive learner experience and performance. Overall, both the students' free-form remarks (Qualitative) and Quantitative (Likert scale ratings etc.) results indicate that the learning experience for the learning environment (i.e. group-work with continual student and tutor led feedback, along with the real-research robot task based project approach) has been appreciated by the students. Access to the research undertaken by the Adaptive Systems research group, with a specific focus on robots, including both Human-Robot-Interaction and Human-Computer-Interaction, added value to the learner's experience. Some learners complained that problems in freely accessing the particular robot that was the subject of their project work had adversely affected their experience, and this was tentatively supported by the quantitative analyses findings. However, as no data on the students' Robot Task chosen or project group composition was collected, this result is speculative.

For studies of this type in the future, it is recommended to make some changes to the study procedure and questionnaires in order to allow for a more detailed analyses to include the project task and learner group composition to be examined for effects, and also to refine the range and scope of the statistical analyses This study raises several questions, which are left for future work.

Overall, it has been shown the pedagogical approach used underpinned by Research to Inform Teaching was valued by the learners. The pedagogical blend included the assessment design and the teaching and learning practice was informed by current research taking place in the School of Computer Science at the University of Hertfordshire. Providing learners with access to the research centre and the robotics house to study the robots helped learners to progress learning and complete the group based assessment.

This study adds to the debate on Research Informed Teaching providing a pedagogical approach embedded in research to inform teaching practice in order to enhance the student learning experience. As has been shown Research Informed Teaching is specifically of importance across the United Kingdom at university level.

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# Students' Perceptions About Learning Management Systems in Education: Case of Zimbabwe

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**Abstract** This paper investigated the postgraduate students' perceptions about Learning Management Systems (LMS) tools in elevating pedagogical practices. This was after observing that despite the wider embrace of Information and communication technologies (ICT) in higher education, the uptake of such ICTs as the LMS tools was still at its infancy in the developing African contexts such as Zimbabwe. Furthermore, the students' LMS perceptions are limited in literature where much relates to the technical issues of the LMS and less on the role played by the institutional structure in influencing students' perceptions about the ICT resources. Both quantitative and qualitative data were collected from a single university case's postgraduate students who were selected using the purposive sampling technique. Of the thirty administered, twenty-seven paper based questionnaires were successfully completed and returned. Additional data were also collected from the same cohort of students grouped into nine focus groups with at least three students in each group. Although there were indications of satisfaction with ICT enabled learning, the students also revealed many concerns, which require to be addressed by the institutions prior to selecting and implementing future ICT based learning technologies. Emerging from the findings are concerns relating to the issues of LMS tools availability, accessibility, usability and compatibility, themes which were neither individual nor technological but institutional. The findings have an implication on the higher learning institutions that are challenged to be more cognisant of the institution's environment and structures if added value is to be realised from the implementation of ICT resources in education.

**Keywords**: postgraduate students, LMS, pedagogy, higher learning, developing country

## 1. Introduction

There has been a notable change in education towards the integration of Information and Communication Technologies (ICT) in the teaching and learning practice. ICTs in education have resulted in learning paradigms described in Table 1.

**Table 1** Common ICT enabled learning paradigms

| Learning Paradigm | Definition | Example |
|---|---|---|
| E-learning | Learning that is dependent on the internet connectivity and is facilitated by LMS such as Sakai, MOODLE, Blackboard etc. | MOOC |
| Blended learning | It is learning that combines multiple approaches to learning where different delivery methods are combined together to deliver a particular course (Hassan, 2014) | A mixture of face-to-face and online learning technologies such as a LMS |
| Mobile learning | It is learning that utilises mobile devices such as smart phones and their associated applications in the learning process | Mobile educational applications such as Chrome and Safari browsers for browsing information and Evernote |
| Cloud learning | is learning that occurs through cloud computing, clusters of distributed computers which provide on-demand resources and services over a networked medium such as the internet | Google Drive, Drop box etc. for data storage and information sharing. |

Table 1 depicts the most common ways of integrating the emerging technologies into the teaching and learning practice. Learning Management Systems (LMS is the most common paradigm that has been embraced by the higher learning institutions. For instance, (Dahlstrom & Bichsel., 2014) posit that LMS as a digital learning environment has great potential to extend the traditional classroom The change towards These systems has been necessitated firstly by the ever increasing demand for higher education that has resulted in the increased enrolments beyond the available resources. Secondly, the price reduction in ICTs has forced the higher education institutions to take advantage of their affordances such as their ubiquitous nature, flexibility, affordability, availability and access to enhance teaching and learning. Thirdly the current labour market requires employees who are technologically savvy and capable of facilitating the economical, technological and personal development of any society in accordance with the 21st century digital society demands. It is on this premise that LMS is an e-learning platform facilitator that has become the most embraced teaching and learning method in higher education institutions the world over. The affordances of LMS tools have been attractive to many learning institutions even those in developing and economically challenged countries. In such countries like Zimbabwe HEIs have jumped on to the technological wagon with the intention of embracing the affordances ICT resources in education. In this regard, Zimbabwean President has spearheaded the implementation of LMS not only at higher but at the grass root primary school level (Kabanda, 2013). The aim is providing learners with technological grounding and equip them with skills for survival in the digital society in accordance with one of the stipulated Millennium Development Goals (MDGs).

Contrary, though, in the current Zimbabwean context, technology based education is not yet visible. This is evident in prior research by, (Dube & Scott, 2014) who investigated the use of Sakai LMS at one of the sixteen universities in Zimbabwe. The findings are indicative of a paradox of the second order digital divide, which is a disparity between access to and use of the costly technological investments in pedagogy. The situation is robbing the HEIs institutions of returns from technological investments as well as depriving learners of the opportunity to benefit from the ICT affordances like their counterparts in the developed world context. We therefore extend our previous work by investigating the post graduate students' perspectives about the use of the web based technologies in pedagogy. The motive is lack of consensus in existing literature about the role played by these technologies in the elevation of pedagogy. On one hand are the techno positivists for the technology in class while on the other are the negativists who view technology as a learning disruption tool. While it is argued that it is the responsibility of the teacher to ensure effective use of ICTs in class, students' perception also have an impact. However, there is limited research focussing on the views of the post graduate students, an under researched group within the empirical situation of HEIs in Zimbabwe. It is on this premise that this research sought to answer the subsequent questions relating to the post graduate students within the LMS domain.

## 2. Research questions

The main question this paper sought to answer is:

What are the Zimbabwean students' perspectives about LMS tools in pedagogical achievements?

The answer to this question was made possible by first answering the underlying sub questions:

- What are the students' perceptions of LMS tools in teaching and learning?
- What are the students' concerns in relation to LMS tools usage towards their academic achievements?
- What are the students' perceived preferences regarding the pedagogical LMS' features and tools?

Answers to the preceding questions are of relevance to the researchers concerned about the limited literature discussing students' perceptions about using LMS as educational tools as depicted in Table 2. LMS use in higher education has been viewed from various perspectives such as from the instructors' / lecturers' point of view (Schoonenboom, 2014) and less from students'. view point., However, like (Alexander & Golja, 2007) this article emphasizes the need to move from the "techno-centric" approach and recommends a focus on the individual students' perceptions for a more informed decision about the impact of LMS tools in education.

**Table 2** Researchers' concerns about limited research on the students' LMS perspectives.

| Year | Source | Observation |
|---|---|---|
| 2010 | (Paechter, et al., 2010) | Indicate that although the application of e-learning at universities has increased rapidly, little is known about students' expectations and experiences. |
| 2011 | (Vanderlinde & van Braak, 2011) | Shows that in terms of ICT in education, little attention has been given to the role of perceptions of individuals such as the students. |
| 2012 | (Frankl & Bitter, 2012) | They claim that literature and research studies on eLearning and/or blended learning from a students' perspective are limited. |
| 2013 | (Lai & Savage, 2013) | The study depicts that existing studies have focussed more on the economic and technical challenges of LMS adoption and less on the |

| Year | Source | Observation |
|---|---|---|
| | | students' view of them as pedagogical tools for supporting teaching and learning. |
| 2014 | (Mbengo, 2014) | Research considering students' perspectives about e-learning systems is scanty. |
| 2015 | (Waheed, et al., 2015) | There is limited research exploring students' perceived learning effectiveness and academic performances from the use of e-learning portals. |
| 2015 | (Montrieux, et al., 2015) | The study emphasizes the need to investigate the students' perceptions about ICTs such as LMS. |

Table 2 shows the concerns of researchers about the under research on students' perspectives about the e-learning in education particularly the students' opinions about the use of LMS tools in education. From the table is an indication of the persistence of the gap in literature currently existing in literature, hence the need to investigate the phenomenon. From Table 2 it is clear that within the five-year period from 2010 to date, studies conducted on students' perspectives are biased towards other nations than developing countries such as Zimbabwe. Furthermore, none of these studies have focused on the Post graduate student perceptions regarding the pedagogical use of features and tools embedded in a Sakai LMS. Our study attempts fill this gap in the knowledge body by documenting the perceptions of this under researched group of students regarding their perceptions about, the pedagogical uses of LMS tools (Lonn, et al., 2009) from a developing country perspective (Mbengo, 2014). We therefore found it imperative to conduct this study because students' perspectives play a significant role in determining their LMS adoption (Murshitha & Wickramarachchi, 2013). This has also been motivated by (Njenga & Fourie, 2010) arguing that "Before making an investment in e-learning, there should be a clear understanding of how it supports the core goals of the institution in relation to the characteristics of its potential customers" in this case the postgraduates. According to the same authors, such an insight can prevent the danger of investing in costly technologies that do not add value to the learning practice.

Another problem is that much of existing studies such as by (Dahlstrom & Bichsel., 2014) and (Kennedy, et al., 2006) are targeted on undergraduate students mainly in developed nations, with circumstances and conditions of technology use that differ from those in our empirical situation hence this study. The research findings are of practical benefit to policy makers of higher learning institutions currently experiencing a second order digital divide problem, which (Njenga & Fourie, 2010) attribute to the "techno positivist ideology " that has denied them the much needed foresight into the priorities of the core stakeholders (students). Incorporating their perspectives could hinder uninformed adoption of LMS tools that have always resulted in unintended consequences detrimental to higher education. Understanding and addressing the complexities of the postgraduate students would therefore ensure more effective LMS adoption and ensure more usage.

Prior to answering the preceding questions, we reviewed existing literature pertaining to the general knowledge in existence with reference to the students' about LMS as educational tools. The next section is a discussion of the reviewed literature.

## 3. Literature review

The effective use of technology such as has the potential to improve and enhance learning (Njenga & Fourie, 2010) The LMS is one such technology that has been well researched since its inception in the 1990s as a training tool, which has however had a limited focus in relation to its pedagogical appreciation by postgraduates in developing countries where the uptake is still at its infancy (Bhuasiri, et al., 2012). LMS are "enterprise-wide and internet-based systems, such as Web CT and Blackboard that integrate a wide range of pedagogical and course administration tools" (Coates, et al., 2005). These systems can be acquired as a commercial such as Blackboard or as an open source system like Sakai with a wider application area. In education LMS tools have been either used to achieve a fully online virtual classroom environment or on campus to complement and blend with the traditional face to face teaching and learning method. In the latter setup, LMS tools have been found useful in facilitating asynchronous and synchronous communication, course content development and delivery, summative and formative assessments as well as class and user management.

Several Studies have been conducted on LMS, which however, (Coates, et al., 2005) posit that their attention has been mostly focussed on technical, financial and administrative aspects. It is on this background that these authors critically examined students' perceptions of LMS-mediated interactions with staff and fellow students. Their findings reveal that students perceive the LMS systems as a general part of university infrastructure rather than as special tools which add value to their learning.

On the contrary, findings from a report by (Kennedy, et al., 2006) who surveyed about 2000 first year undergraduate students at the University of Melbourne clearly show that students appreciate technology enabled teaching and learning. This is evident in the students' endorsement of their use of technology based tools such as the LMS and other web based technologies for university studies.

A study with similar results was conducted by (Lonn, 2009) who investigated how students use LMS to interact, collaborate, and construct knowledge within the context of a group project. The findings concur with the preceding discussion as it confirms that students found several tools and functions of the LMS useful for their online peer interaction and completion of their course project.

A study by (Lonn, et al., 2009) explored the differences between undergraduate students at a large residential campus with students at a smaller commuter campus who used the same LMS. Their results indicate that all students rated LMS activities and tools quite highly, although there were significant differences in use between campuses, which they attributed to different patterns of interaction between students and instructors at residential and commuter campuses.

A similar study was conducted by (Weaver, et al., 2008) whose survey results revealed that a student cohort of 1314 from Monash University was generally satisfied with their experience of using Web CT, which they learnt to use on their own and could easily trouble shoot and resolves encountered errors and problems. The findings from the same study also revealed that students were dissatisfied with poorly designed and maintained online courses indicating the importance of quality assurance if online learning is to be highly valued in education.

An investigation at the University of Kelaniya on students' perspectives about the adoption of LMS in blended learning environment by (Murshitha & Wickramarachchi, 2013) show that students perceive that using the LMS would enhance their learning task in numerous ways.

In a more recent study, (Dahlstrom & Bichsel., 2014) investigated undergraduate students and Information Technology and found that Students' academic use of technology is widespread but not deep. For example, about (83%) have used the existing LMS in at least one course while only about half (56%) have used it in most or all of their courses. Showing a rather low uptake given that 99% of higher education institutions have an LMS in place and 86% of faculty say they use the LMS. Never the less, the study demonstrates that students value the LMS as an enhancement to their teaching and learning experiences, even though relatively few use these systems to their full capacity, an indication that something is not right.

In conclusion, the literature reviewed in this study has one common denominator that undergraduate students value the LMS as critical to their studies. However, students rarely make full use of LMS as it lacks a mobile-friendly, highly personalized, and engaging platform, which is what today's digital native undergraduates want to experience in online environments (Dahlstrom & Bichsel., 2014).

## 4. Contextual background

Zimbabwe is a Southern African country with a population of about 13 million people, the majority residing in rural areas. The country is currently faced with severe economic hardships, with over 60% of the people living below the poverty, which is attributed to a very high unemployment rate of approximately 95%. Zimbabwe has also made history through her highest inflation rates that led to the abandonment of the local Zimbabwean dollar for a multiple currency system involving stronger currencies such as the United States Dollar, Great Britain Pound, South African Rand among other currencies.

However, these economic challenges have neither disrupted formal education nor impacted negatively on the high value attached to education. The demand for higher education has always been increasing and leading to a visible increase from a single university at colonial independence in 1980 to the current nineteen public and private universities with prospects of at least a university in each of the country's ten provinces. Such emphasis on education could be the reason the country's high levels of adult literacy currently at 90.4%, a rate above the regional and global averages. Nevertheless, one of the major effects of the Zimbabwe's economic hardships is high staff turnover and the brain drain, which has seen the country losing her expertise to other countries viewed by local people as greener pastures. This has had an impact on higher education, compelling the country to consider alternatives such as the adoption of ICTs. It is on this premise that the universities are embracing such ICTs as the LMS technologies to enhance the quality of higher education for the betterment of both the individuals and the society at large. Like her counterparts, the university under study implemented the Sakai LMS in the year 2012 as a move towards facilitating e-learning. It is the features and tools of this LMS that the study sought to derive their value from the students as discussed in the subsequent section.

## 5. Research method

Data was collected from a single university case because existing studies such as by (Yin, 2014) indicate that more insight can be gained from analysing a phenomenal behaviour within its natural setting. The choice of the university was inspired by its mission and vision mandated to producing technologically savvy personnel in accordance with the 21st century labour market requirements. The chosen university has seven faculties that offer science and technology courses to over nine thousand undergraduate and post graduate students. Both quantitative and qualitative data were collected from a class of thirty-first-year part time students currently enrolled in a Master of Science in Information Systems degree programme. Thirty paper based questionnaires were administered to the students based on a purposive sampling technique. The aim was to collect data relating to the students' view about the helpfulness, availability, user support and adequacy of training on the institutional Sakai LMS. A 90% response rate was achieved with twenty-seven questionnaires containing clean data returned, one questionnaire discarded due to too many missing entries and two questionnaires were never returned. Qualitative data were further collected from nine focus groups each with at least three students. This approach was intended at verifying and validating the data collected using the survey method. The focus group method would complement as well as facilitate for further elaboration of the students' concerns about the institutional for a more complete understanding of their perceptions. We also analysed the statistics and logs of the institutional Sakai LMS to ascertain the students' activities and the actions they took with specific tools to determine where their interest is mostly in. Both the survey and focus group discussion questions were informed by the concepts of Giddens' Structuration Theory, which is discussed in the next section.

## 6. Theoretical perspective

Both the survey and interview questions were formulated based on the concepts of (Giddens, 1984)'s structuration theory which emphasizes the duality of structure and agency. The theory differs from the common existing human and technology deterministic theories by incorporating the dualism of structure and agency such that the level of analysis goes beyond the micro to include the macro issues. This is a better approach because the trend has been to analyse students' perceptions on the basis of the technology or human aspect, a determinism problem countered by the structuration theory. The concepts of the theory provide opportunities to explore the motives, power, rewards and sanctions (Njenga & Fourie, 2010) of LMS from the postgraduate students' view point in order to inform future technology related decisions made by learning institutions' policy makers. More so, both intended and unintended consequences could be identified from the students' shared meanings about LMS tools in the education context such that unacknowledged behaviours that are detrimental to the learning practice could be avoided. The role played by the institutional structures can be determined from the extent of the students' appreciation and the value they attach to the LMS as a learning tool.

The structuration model depicted in Figure 1 enables the analysis of the postgraduates' perceptions through the three dimensions of structure in the upper part of the model, which are linked to three dimensions of agency at the lower part of the model via the three modalities in the middle part of the model.

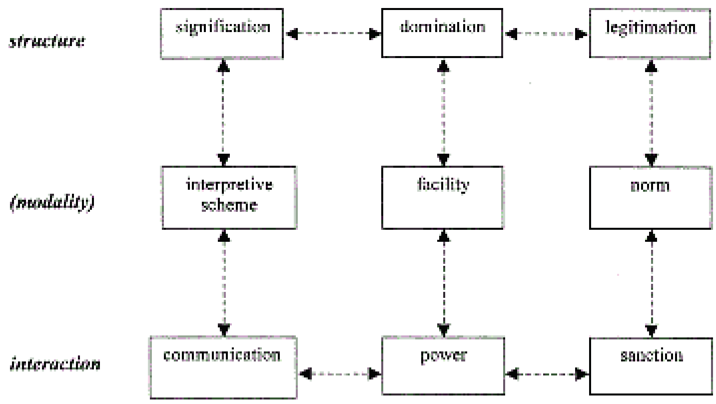


**Figure 1:** The structuration model adopted from (Giddens, 1984)

Figure 1 depicts the dimensions of both the structure and agency that are mediated by the three corresponding modalities. Signification is about meanings attached to the LMS tools and features that can be produced and reproduced over time and space depending on the interactions that take place among students, with the lecturers and the institution authorities. Domination structure is a result of enforcing the mobilising the students to adhere to the authorities with regards to the availing and use of LMS resources and submit to the powers associated with the resource allocation. Institutional norms can act as sanctions constraining students' zeal to legitimately use the LMS tools for both the learning and study purposes. The following section is presentation of results after analysing both the quantitative and qualitative data collected from the postgraduate students at a university case under study.

## 7. Findings

After the analysis of both quantitative and qualitative data using the statistical package for social sciences (SPSS) and Atlas ti respectively, the results were discussed with an intention to get answers to the research questions discussed earlier. In an attempt to answer the first question on the students' perceptions about the institutional LMS we found that students value the integration of LMS tools in teaching and learning. There is evidence in the results that LMS is a well appreciated tool for enhancing both the learning and the studying process as indicated in the responses to the question on the helpfulness of the LMS tools. The results show that 94.7% of the surveyed students find value in the LMS tools as depicted in Table 3.

**Table 3** Perception about The LMS tools' helpfulness

| | | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | Poor | 5.0 | 5.3 | 5.3 |
| | Average | 55.0 | 57.9 | 63.2 |
| | Good | 30.0 | 31.6 | 94.7 |
| | Very Good | 5.0 | 5.3 | 100.0 |
| | Total | 95.0 | 100.0 | |
| Missing | 9 | 5.0 | | |
| Total | | 100.0 | | |

These statistical data were elaborated on through the focus group discussions, which lasted between 15 and 20 minutes and were recorded through a voice recorder. Table 4 is an extract from the group discussions that confirms how the students perceive the LMS features as tools for enhancing their learning and study practices.

**Table 4** LMS perceptions of students based on focus group discussions

| Respondent | Response |
|---|---|
| A | I like the LMS capability of accessing it from anywhere like online tests, which is good. |
| B | The LMS features enable us to share notes and cooperate on the leaning tasks. |
| C | I believe that when used appropriately, the Sakai LMS is a good platform for interacting among ourselves. |
| D | It is a user friendly platform where I can easily locate the information that you require. |

| Respondent | Response |
|---|---|
| D | As a learning tool, Sakai LMS is a very good system as it assists us to interact with our Lecturers. |

After gaining an insight into the students' views about LMS tools in pedagogy, the next question to be answered was on the students' perceived preferences regarding the institutional LMS' features and tools. The students had a wider choice of features and tools they indicated were supporting their learning and study processes. Common features of interest included the Test and quizzes, chat, grading tool, announcements and the resource feature from which they access and download both the course syllabi and course notes. Table 5 has examples of such students' preferences.

**Table 5** Students' preferred LMS features and tools

| Respondent | Response |
|---|---|
| A | The features of the LMS are appealing and the graphics of the user interface are good. |
| B | I like the chat, the blog for collaboration with fellow students, the email system and the integration with the online registration system and the use of the same log in details for the Wi-Fi, and the student portal which is convenient for us all. |
| C | I like the test/quizzes feature as we can do the assessment from the comfort of our homes or offices and also where I can submit an assignment. |
| D | I like the e-resources feature which allows me to download and share the course notes. |
| E | You don't need to seated in front of your desktop or laptop to use it. You can even use whatever mobile device you have because it can easily adapt to the screen of the devices you are using. |
| G | We can share files through the drop box feature. |

Both the survey and group discussion responses clearly demonstrate that the students' knowledge of using the LMS features is limited as indicated in the concentration on selected few tools from a very wide and varied choice. However, the students did not elaborate on the reasons for limiting their choice of features and tools that they find useful in the learning and study activities.

To provide an insight on the students' concerns relating to the LMS tools, the students were asked to identify challenges they faced in using the Sakai LMS for academic purposes. The major themes which emerged from analysing content from the students' responses include issues of Sakai system availability, accessibility, usability, integration, user support, functionality, standardisation etc. as depicted in both the statistical data and content analysis.

In this context system availability refers to the amount of time students can use the Sakai LMS tools without any disruptions. When asked through the paper based questionnaire on their opinion about the LMS availability, the responses indicate that the system is on most occasions down than up for usage as demonstrated by the statistics in Table 6. Table 6 shows the results from a Likert scale where students were asked to rate the Sakai LMS availability from strongly agree through to strongly disagree. He results reveal that only 25% of the respondents strongly agree that the system is always available as when they wish to use it to enhance both learning and studying. Apart from those who simply agree and were neutral, the majority represented by 40% of respondents indicated their frustration on the non-availability of the system for academic use.

**Table 6** Sakai LMS system availability

| | | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | Strongly Agree | 25.0 | 25.0 | 25.0 |
| | Agree | 15.0 | 15.0 | 40.0 |
| | Neutral | 20.0 | 20.0 | 60.0 |
| | Disagree | 20.0 | 20.0 | 80.0 |
| | Strongly Disagree | 20.0 | 20.0 | 100.0 |
| | Total | 100.0 | 100.0 | |

Another major concern emerging from the statistical data is the inadequacy of training with Table 7 showing that 50% of the respondents are dissatisfied with the level and frequency of training offered by the institution.7.

**Table 7** Sakai training adequacy

| | | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|
| Valid | Strongly Agree | 20.0 | 22.2 | 22.2 |
| | Neutral | 15.0 | 16.7 | 38.9 |
| | Disagree | 10.0 | 11.1 | 50.0 |
| | Strongly Disagree | 45.0 | 50.0 | 100.0 |
| | Total | 90.0 | 100.0 | |
| Missing | 9 | 10.0 | | |
| Total | | 100.0 | | |

These statistical findings were further augmented in the focus group discussions as depicted in Table 8

Emerging from the concerns so far discussed is an implication that the institutional structures are at fault. The institution has failed to put structures that promote the LMS availability, accessibility, usability and compatibility. It has also failed to set up and enforce standards and policies that encourage the use of the LMS tools across all faculties. The institution is to do more towards ensuring that all students regardless of their learning mode are accommodated in the allocation of the institutional services particularly those relating to the availability, accessibility, usability and compatibility of the institutional LMS resources.

**Table 8** Students' concerns about the Sakai LMS availability

| Respondent | Response |
|---|---|
| A | The drawback is the availability of the system which is always down. It is not always up and running and such you cannot do your work on it, for example the tests have a time frame and if you miss it then it means you get a "0" in the grade book. |
| B | The system is always slow in opening navigated links and sometimes freezes (crushes). For example, it froze while I was in the middle of answering the test questions on line and had to be graded based on some of the questions that I had even attempted. |
| C | It is difficult to navigate the system features because I cannot visit the previous page without being forced to log out and then log in again to access the previous link. |
| D | The e-learning platform is not always available and right now it is still down. |
| E | As students we do not know how the other features of the Sakai LMS function except downloading the notes and doing tests and quizzes. |
| F | It took me almost the whole day to navigate where I could access the e-commerce test until after I called someone who told me how to navigate the system. |
| G | Not all lecturers use the system even though they are the ones who have to drive it. When you log on to the system you do not find anything because lecturers have not uploaded anything. |
| H | Although we use the same credentials for both the Sakai LMS and the student portal, we cannot make a single login and interact with both systems at the same time but have to keep logging in and out of the two systems. |
| I | There is one thing that I don't like about the system that I have to log in twice into the LMS and the student portal using the same credentials why not integrate the two systems so that once I am logged in I can access both systems. |
| J | There are connectivity issues. Some of us who are not always on campus, we are not able to access the system at times. |
| K | The system performs slower when there are many people logged on. |
| L | The system is not properly customised; it is mainly cluttered with redundant tools not suitable for the context. |

## 8. Conclusion

Although the findings concur with existing literature about the positive perception of postgraduate students about the LMS tools, the target group's application of the available tools is limited and constrained mostly by the institutional factors more than the users and technological issues. This is evident in the list of concerns mainly directed to the institution. Thus confirms the role played by the institutional context in influencing the way students view an ICT innovation. The structuration model dimensions of structure and agency were very useful for uncovering such concerns requiring redress from the institution. The content analysis revealed such themes as system availability, accessibility, usability and adaptability, which have had limited discussion in existing literature that has been biased towards human and techno-centrism. The institutions in a similar position are therefore challenged to reconsider their approaches towards both the choices and implementation of ICT innovations if both students are to benefit from their affordances and returns are to be realized from the costly ICT innovations.

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# E-Learning in Africa and the Implication of the new Partnership for Africa's Development (NEPAD)

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**Abstract**: The New Partnership for Africa's Development (NEPAD) has convincingly initiated the inclusion of e-learning in much African school. NEPAD is a program of the African Union (AU) that thrives of putting Africa in the path for socio economic development. The NEPAD e-Africa Commission is the NEPAD Task Team responsible for developing and implementing ICT projects, one of which is the NEPAD e-Schools Initiative. The aim of this research is to explore the extent to which the incorporation of technology in teaching and learning has so far benefited teachers and learners in Africa. The objectives of the study are to highlight the benefits of using e-learning system to find out whether new technologies have enhanced teaching institutions in Africa.

**Keywords:** NEPAD, ICT, e-school, African Union, Africa

## 1. Introduction

The New Partnership for Africa's Development (NEPAD) is one of the organs of the African Union (AU). It aim is to put Africa in the path of socio economic development. The overall goal is the development of an integrated socio-economic development framework for Africa. The NEPAD e-Africa Commission is the NEPAD Task Team responsible for developing and implementing ICT projects, one of which is the NEPAD e-Schools Initiative. According to Sandy Malapile (2007) the aim is to equip all African primary and secondary schools with ICT equipment, such as computers, radio and television sets, phones and fax machines, communication equipment, scanners, digital cameras, copiers, etc., and to connect them to the Internet.

As initially highlighted by *Edoun et al* (2016) this study set to explore the role of ICT on e-learning in Africa and it implication on Africa's development through NEPAD initiative. More specifically, this study investigates the effectiveness of developing electronic learning system (e-learning) in line with the objective of the New Partnership for Africa's Development (NEPAD). NEPAD is a programme of the African Union (AU). It aim is to put Africa in the path of socio economic development. The overall goal of NEPAD is the development of an integrated socio-economic development framework for Africa.

The NEPAD e-Africa Commission is the NEPAD Task Team responsible for developing and implementing ICT projects, one of which is the NEPAD e-Schools Initiative. In line with the above Integration of technology in teaching and learning has become a priority for many institutions, with the primary objective of empowering students to become computer skilled end-users with sound knowledge of the most recent technological platforms (Highton, 2009). To convey a well-adapted e-learning teaching and learning system, Mbithi (2014) inferred that it calls for more insights of the adaptability and this depends on the philosophy of approach, the structure, and the culture of the institution adopting e-learning. Vice-versa, e-learning implementation should also get into the practicability of the learning and management system in place and further improve the system to more efficiency and effectiveness. As Edoun et al (2016) posit the introduction of the e-learning approach in support for teaching and learning in Africa has brought many benefits to both learners and lecturers as per the objective of NEPAD which is to equip the majority of African learning institutions with up to date ICT.

## 2. Literature review

Edoun, Mbithi and Mabiza (2016) argued that, e-learning is expressed as a form of teaching and learning that supports communication between lecturer and learner with tailor-made programmes conveyed via the computers or mobile devices and aided by quizzes, games, as well as video to enhance learning opportunity. E-learning covers training that deliver just-in-time information and guidance from experts in both education programme and set of technology used (Chadwick, 2013).

Edoun *et al* (2016) argued that, e-learning as a digital method of learning may be used as a standard method but not as a substitute to learning methods that do not make use of digital platforms. Lipshitz and Parsons (2013) define e-learning as a general term to computer enhanced learning that is used interchangeably in many ways.

In many circumstances, advanced learning technologies making use of multimedia and networked technologies are associated with e-learning. E-learning is an interactive way of learning through Information Communications Technology and computer networks (Ortiz, 2013).

Helen (2013:2) defined e- learning as a learning approach that requires the use of basic information technology resources mainly the computer as the central processing system of activities and composed of hardware and software, and a number of external peripherals input and output data as well as network connections for data exchange with broad external environment. Intranet network and the Internet are the network connections in reference. E-learning content is part of data exchanged within e-learning system. Minaar (2011:84) sees e-learning to be the use of the Internet for accessing learning contents by students with more interactive lectures as a valuable tool facilitating help to reach the students individually in an effective way and at any given time. The system increases lecturer-student interaction which results to student more engaged individually and responsibly into the learning process and the gaining of knowledge vital to develop student personal skills.

In line with the above Jennifer *et al* (2011) convincingly argued that the impact of e-learning on student achievement is complex and mediated by a range of other factors affecting achievement. They argued that, their effectiveness is closely related to how the technology is used as an educational tool. They inferred that, students learn best with e-learning when interactively engaged in the content. They further argued that, that, the use of technology could motivate many students in general and underachievers in particular.

In their analysis Jennifer *et al* also posit that, the economic impact of e-learning can be examined up front through the identification of the impact of e-learning and improvements in education on the workforce and employment followed by the effect of a high tech workforce on the national economy. The African continent could therefore continually seek to improve its education systems by introducing high-tech systems that will equip its learners with the required skills. It is in this way that, Africa will certainly be experiencing the increase in its Gross Domestic Products which will subsequently lead to an increase in workers incomes in many countries. Therefore if the fiscal policies are well structured in these countries, governments could generate more revenue by mobilising funds through tax. These funds if well utilised will contribute in building the most needed infrastructure for regional integration and socio economic development. It is in support of the above that Jennifer *et al* (2011) further inferred that, as technology and knowledge spill overs are the foundations of modern economic growth, it is important to ensure that the workforce has the skills to meet the need of these 21st Century jobs".

Kanter (2012:399) argued that, that e-learning system is faster to be implemented compared to the traditional system analogue, opposed to the digital. However; if e-learning is not properly implemented, it can be exclusionary. E-learning users should be put in training for them to be efficient and effective in the use of the system at the best. Edoun *et al* (2016) argued that, with the e-learning approach, knowledge is likely to be shared, individually or collectively by clicking on a command button from a personal computer, Mobile phones or IPADs. Knowledge sharing can be done by publishing narrative comments, dialogue, multiparty interactive discussion and video conferencing. Individuals acquire data, information, knowledge and skills. With e-learning, learners require a computer or an Internet connecting cell phone and available Internet access network. In achieving e-learning efficiency, academic management team should discuss with its departments the selection of e-learning strategies that work effectively for teaching and learning (Kelkar, 2012 and Rosenberg, 2012).

According to Wang, H.K., Wang, H.T., Wang, L.W and Huang (2011:1-4), main problems to e-learning environment adaptability exists by lack of personalisation. Most of education centres were never built with e-learning project in mind. E-learning systems need to be adapted to suit preferably an existing infrastructure. Furthermore, in a learning environment Wi-Fi hot spots free area layout should be promoted. Should these Wi-Fi hot spots also be accessed from laboratories, certain restrictions to the relevant information for students to the sole reason of learning should be imposed? Wang et al. (2011:4) supports some of the above statements by suggesting the matching of the education system to a specific learning implementation or bringing a change to learners' preferences to match the e-learning system.Rao (2010:114) defines e-learning as dynamics of instructional information that is delivered electronically through the web, by means of a firm's intranet, extranet, or through portative devices such as CD-ROM. On-line education is the most popular e-learning type which envisages almost all activities supported by electronic systems and that goes as far as tests activities set in interactive. E-learning is suited to distance learning and flexible learning that capitalises on multimedia, features of video and audio that illuminates topics, navigation that is self-paced including hints, and hyperlinks to affiliated topics (Rao, 2010 ; Khan, 2013).

Open educational or open content resources should be analysed to understand the future of tertiary education around e-learning. Pascal (2013:1) brings forth failures as a result of not having effective e-learning system in place which temporarily overshadowed the hope of gaining a wider and flexible access to tertiary education, and also shown by innovation with cheap costs. Dzakiria, Kasim, Mohamed, Christopher and Utara (2013:112), highlight some limitations to effectiveness of e-learning on-line open sources, which are a lack of computers or cell phones with Internet connectivity for users of e-learning system. Mohamadzadeh, Farzaneh, Mousavi, Ma'ghbal and Moenikia (2013: 149) underscore the challenges presented in the Information Communications Technology (ICT) usage; when it comes to an e-learning environment. In fact, as the e-learning organisation aims to reach its students far and wide, there is a great difference in performance of students, those with ICT access facilities compared to those reaching on-campus lectures.

Magboo and Schwab (2013:2) state that e-learning strategy development is an essential technology "*for blended and online learning*". Blended learning that is not backed by the right infrastructure support at the end side of it can be a complete mess. Issues of bandwidth, services hosting, and lecturer / facilitator access to the online e-learning system are critical in making the blended / online learning a success. Institutions adopting e-learning educational program, should avoid not having a solid strategy in place. When there is no vision, the institution will not know where it is going as any road will take it there (Rosenberg, 2012). Most common mistakes that organisations may be faced with in choosing an e-learning strategy are: Equating technology with strategy, confusing strategy with tactics, looking at development and delivery rather than the bigger business picture, focusing on creating a traditional offer online, going it alone failure to reach consensus, misreading executive support, thinking this is part-time or short term work, ignoring risks; weaknesses and threats, failure to manage change (Rosenberg, 2012:1-3; Cabezas, 2013). E-learning is different from learning methods that do not use on-line or digital platforms hence the need to bring in methods of self-discipline; and motivation to the learners. In the selection of an e-learning strategy, different abilities and qualities of students should be taken into consideration (Freed, 2013).

## 3. Benefits of e-learning and best practices

A number of governments in Africa have aligned teaching and learning goals within e-learning vision to maximise e-learning benefits. E-government is a strategy adopted by governments to facilitate communication through the intensive usage of Information and Communication Technology (ICT). *Edoun et al* (2016) explained that, governments have introduced innovative ways of teaching using the e-learning approach promoted by the New Partnership for Africa's Development (NEPAD). In a paper presented to the ICBTS conference in Paris Edoun *et al* (2016) presented the New Partnership for Africa's Development (NEPAD) as one of the programs of the African Union (AU) that thrive for Africa socio-economic development. *Edoun et al (2016)* also inferred that The NEPAD e-Africa Commission is the NEPAD Task Team responsible for developing and implementing ICT projects through governments in Africa, one of such project is the NEPAD e-Schools Initiative. Since the inception of the e-school initiative, many primary, secondary schools and institutions of higher learning have benefited from this project. They have become conversant with high performing ICT equipments in the form of computers, radio and television sets, phones and fax machines, communication equipment, scanners.

The Integration of technology in teaching and learning has therefore became a priority for many institutions, with the primary objective of empowering students to become computer skilled end-users with sound knowledge of the most recent technological platforms (Highton, 2009). To convey a well-adapted e-learning teaching and learning system, Mbithi (2014) inferred that it calls for more insights of the adaptability and this depends on the philosophy of approach, the structure, and the culture of the institution adopting e-learning. Vice-versa, e-learning implementation should also get into the practicability of the learning and management system in place and further improve the system to more efficiency and effectiveness.

It is also important to highlight that, the introduction of e-learning to teachers and learners is positively correlated on improving students capacity to understand the rationale of the course because the students are exposed to the effective use of technologies that become user friendly for teachers and learners who through this process become more confident as a result of interacting with e- learning concepts.

## 4. Lesson learned

In quoting (Nfila, 2009), Edoun et al (2016) agreed that, encouraging a culture of e-learning scholarship amongst students, in accessing libraries' e-services, e-learning materials, and e-research within the e-learning environment was critical. It is further transpired that e-learning support to staff in the provision of online academic tools for teaching and learning with students were supportive to traditional lecturing methods (Highton, 2009). In working with colleagues: the collaborative and interactive forms of e-learning are explored. There is an opportunity to design and develop e-learning resources for learners (Sweeney, 2013; Highton, 2009). Staff and management support in e-learning institutions should be provided with tools or facilities that support the delivery of academic lecturing of high quality (Siragusa, Dixon and Dixon, 2013).On the other hand e-learners may end up with a bogus certification or degree if the providers of e-learning education are not authenticated, accredited and quality assured to be the providers of such a qualification. Social aspects of real classroom environment are missing in an on-line learning environment when it comes to face to face interaction. Certain skills require hands on training that you cannot get such skills through e-learning, like computer repair, plumbing, welding. E-learning is seen not to be for everyone. The fact that there is vast content on-line does not mean one may learn from it. It takes motivation and development of good study habits (Khan, 2013).

Mbithi (2014) argued that, the choice of an e-learning system should compress the learning programmes with learning tools that are useful in achieving learning outcomes in a space of time that may be said to be limited (Nilsson, Ostegren, Fors, Rickenlund, Jorfeldt, Caidahl, and Bollinder , 2012:1-9). E-learning may be based on different ways to enhance learning, though little is known as to how optimally it is being utilised (Nilsson et al., 2012 ; Lucas, 2013).vAnother important aspect in the effectiveness of e-learning is that the quality of e-learning programmes may be influenced by factors such as interaction levels defined by interactions student to student, student to instructor, and student to learning program (Dzakiria, Don, and Abdul Rahman, 2012).

## 5. Conclusion

Equipping learners and teachers with e-learning tools will certainly prepares them to become experts in their field of study for Africa's development as advocated by NEPAD .Tthe NEPAD e-Schools Initiative is a well thought strategy that is being implemented for learning and teaching in African academic institutions. The benefit as a result of the introduction of this initiative is extremely positive for both learners and lecturers. In his analysis on what institutions could gain from e-learning, Mbithi (2014) emphasized that, the competition amongst learning institutions is more directed on the quality of learning experience comprising quality on-line learning programmes supported by on-line information, administrative and technical support services.

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# Implementing Machine Learning on a big Data Engine for e-Learning

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**Abstract:** Due to high volume, velocity, and variety (referred to as "3V") of data production, the term "big data" has recently emerged. Because of such fast data growth, Data centers of educational institutions are seemingly exploding as well. Therefore, big data is making its way to the field of E-learning. Nowadays large educational institutions feel the urgent need to analyze this flood of data to provide students with higher quality of services. Despite the fact that there is huge volume and variety of data with high velocity of production, the existing traditional methods are unable to analyze such data. In other words, there is little done on implementing learning analytics on big data engines. The author created a scalable machine learning system on a cluster of three machines suitable for large dataset operations using big data engine and implemented an early warning process with machine learning techniques. The dataset was obtained from online and semi-online courses from The University of Tehran. Many features like access time, history of access and history of actions of students were extracted and used for the classification task. A parallel distributed classification process was run to predict students' success and failures. It offers a fast, scalable and in-memory process with apache Spark. Eventually, the research compares the efficiency of proposed method with current and common methods'. The results reveal that our model had a high classification accuracy and the larger the dataset, the more efficient our process will be. It also discusses a new term "learning analytic" and "big data" that are completely new and worth reading. My paper contains worthy information about implementing ELearning data mining on big data engines.

**Keywords:** eLearning analytics, big learning data, eLearning data mining, apache Spark, education

## 1. Introduction

We have reached a point in the path of human evolution; billions of data points are being generated every minute of every day all around the world, like an ocean of information. We have access to large volumes of data in eLearning but we must understand what this large amount of data is telling us and how can we use it.

The present study aims at analyzing such aspects, especially the applications of early warning process and predicting at-risk-of-failure students in eLearning running on a big data engine. We designed and implemented a model architecture for a university eLearning system, based on actual software solutions, having the purpose to organize, access and process huge data sets in apache Spark big data engine.

### 1.1 Big data

Due to the wide adoption of technologies, data from different sources and in different format are being collected at unprecedented scale. This gives rise to the so-called 3V characteristics of the big data: volume, velocity and variety(Cui et al., 2014). Volume refers to ever increasing amounts of data. Velocity indicates the need to capture and analyze high speed or bursts of data in real-time, or else the value may be lost. Variety is related to different types of data, be it structured or non-structured(Ylijoki and Porras, 2016).

Big data also used to describe data sets so large and complex that they become awkward to work with using standard statistical software(Masie, 2013).

The rise of digital and mobile communication made the world become more connected and traceable and has led to the availability of such large data sets(Rainie and Wellman, 2012) Also big learning data is the big data that we apply to our eLearning field and has the potential to play a substantial role in shaping the future of learning from various perspectives.With the rise of more and more online education, data take a completely new meaning. Big data allows for very exciting changes in the educational field that will revolutionize the routines(Uden et al., 2014).

### 1.2 Learning analytics

Data analytics is the process of taking lots of data from multiple data sets, often from different sources, and analyzing them to find patterns, trends, correlations, and similar relationships that might not otherwise be apparent.(Dalto, 2015)much like any other business, eLearning courses need to develop market strategies for attracting new students, hence big data can help with the market analytics within the academic sphere. Indeed, such market research services for academic institutions have reserved the term “academic analytics” for themselves(García and Secades, 2013).

Learning analytics utilizes big data sets, machine learning techniques and data mining to offer better intelligent decisions to their student’s experience. There is two common terms that are close to our area of study: learning analytics and educational data mining. As further clarification learning analytics focus on capturing student behavior and correlating it to achieving learning objectives, while educational data mining tries to design predictive analytics for student attainment(Morabito, 2015). According to the mentioned definition our study is in the field of learning analytics as far as we try to predict the students’ achievements based on the big data set of students’ experiences and logs available on the database of LMS of the university.

### 1.3 The problem

The potential of big data collected from the eLearning has not been explored yet. Big data in eLearning will give the institutions the predictive tools they need to improve learning outcomes for individual students. They can use big data in students’ services and identification of at-risk students (Uden et al., 2014) LMS contains lots of data like pass/fail data, completion/incompletion data, test scores, answers to multiple-choice questions, the time it takes to complete an activity, activities completed, and lots of data(Dalto, 2015).

As Siemens mentioned for educators, the availability of real-time insight into the performance of learners--including students who are at-risk--can be a significantly helpful in the planning of teaching activities. For students, receiving information about their performance in relation to their peers or about their progress in relation to their personal goals can be motivating and encouraging. Finally, administrators and decision-makers are today confronted with tremendous uncertainty in the face of budget cuts and global competition in higher education.(Siemens and Long, 2011)

In addition to all of the data generated by the LMS, Tin Can, also called the Experience API is an eLearning monitoring specification which logs the data about students’ learning paths. It allows, among other things, the tracking of games, simulations, real-world behavior, learning paths and academic achievements. Experience API defines mechanisms and tools for monitoring any imaginable scenario (Del Blanco et al., 2013) and collects more and more learning data from the students learning experiences all around the web. This large amount of heterogeneous data with high velocity of production is no longer processable by traditional methods. Therefore, new techniques and technologies are required to handle such massive amount of data and extracting valuable information from that.

In this paper we propose a model for implementing a big data cluster to handle large amount of data for storage, processing and machine learning tasks in order to create an early warning process in an eLearning platform.

## 2. Apache Spark

Apache Spark is the fastest general purpose cluster computing engine, from Apache, which is very reliable for big data processing. This tool is specialized at making faster data analysis. Spark supports in-memory computing, that enables it to query data much faster compared to disk-based engines such as Hadoop up to 100x. Generally speaking, Spark is advance and highly capable upgrade to Hadoop aimed at enhancing Hadoop ability of cutting edge analysis. This in memory processing capability makes it much faster than any traditional data processing engine. This system also provides number of high level tools such as machine learning tool MlLib, Spark SQL and stream processing engine called Spark Streaming.(Shoro and Soomro, 2015) MLlib is one of several high-level libraries built on top of Spark As part of Spark's ecosystem, and in part due to MLlib's Spark.ml API for pipeline development(Meng et al., 2015)The important point of Spark is that although it can handle large amount of data but its difference from powerful servers is that Spark simulates the similar power of the server by gathering weak and cheap computer systems to create a powerful fast economical cluster.

The main abstraction in Spark is resilient distributed dataset (RDD) which is a read-only collection of objects partitioned across a set of machines that can be rebuilt if a partition is lost. The elements of an RDD do not need to exist in physical storage; instead, a handle to an RDD contains enough information to compute the RDD starting from data in reliable storage. This means that RDDs can always be reconstructed if a node fails.

## 3. MapReduce

The other term to explain is MapReduce. This programming paradigm allows for massive scalability across thousands of servers in a cluster. Let's look at a simple example .The problem is to find the whole number of activities for every specific student between the billions of records, in a parallel solution. In a simple case of four students, as shown in Figure 1, the log file contains just student's names that represent each student's action in the LMS, and the goal is to count the number of occurrence for each name. In this example, student's name is the key and the number of actions is the value. We split the input by lines between machines. Then it goes to Mapper. Input of a mapper is some names, and the output of Mapper is a list of items like (name, 1), which means each individual appearance of a name in the log file.

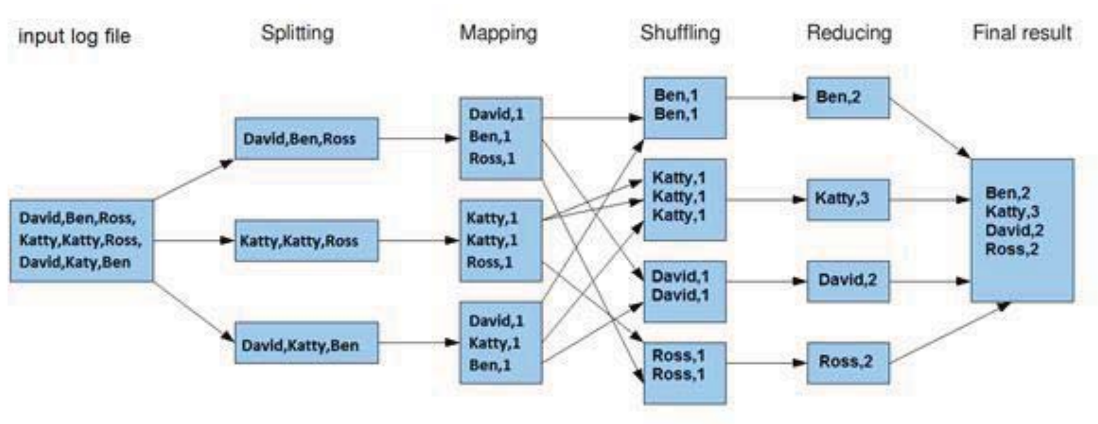


**Figure 1 :** Student's activities count by MapReduce model

Then the MapReduce will group the Mapper output by names, and assign each (name, list of counts) pair to a Reducer. The Reducer just sums up the numbers in the list of counts and returns (name, sum). Figure 1 is an example of counting the number of names using the MapReduce framework. We split the input by lines. So the input to Mapper is a pair of (line#, names in the line), and Mapper returns a list of (name, 1). Then after shuffling step, the pair of a name and a list of counts is sent to Reducer. Each Reducer will returns a name with its count. So this is the simplified form of distributed count task in LMS Logs.

## 4. Methodology

There are massive amount of data like exploding in eLearning systems. Coping with this big learning data specially analyzing in real time has become absolutely impossible with traditional data warehousing techniques.

In this research the data processing is running on a cluster of three virtual machines using two main approaches on same systems: First approach uses Apache Spark methods and second runs on the same engine without using Spark methods. Both of them are performed like process of Figure **2** 2. It actually shows that the data is obtained from the LMS and goes to the cluster of machines. The machine learning algorithms are performed on the dataset to predict the performance of each student and then the student's failures and success (fail/pass) prediction will be sent to the LMS as a feedback, in order to prevent failure of at-risk students.

Due to shortage of hardware capacity, three virtual machine with the total memory of 3.6 GB were configured in order to run the algorithms. This cluster could simulate the operations of a big cluster in a smaller scale with fewer machines. It is also obvious that the real amount of data in real applications may be more than terabytes or petabytes.

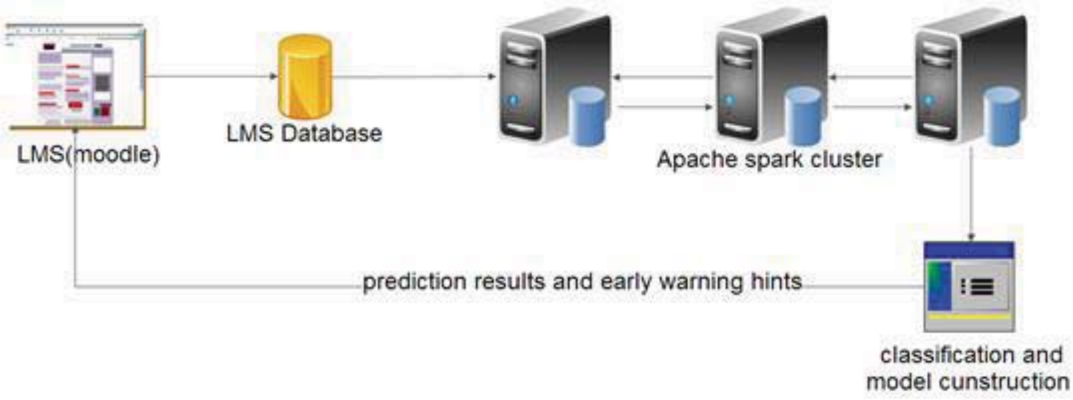


**Figure 2**: The main routine of the project

The data was obtained from the Moodle learning management system (LMS) of the University of Tehran. Because the dataset consisted of noisy data, irrelevant attributes, missing data etc. data needed to be preprocessed before applying any kind of machine learning algorithm. It was done using steps like:

- Data Integration: integrating the tables of students personal features, activity logs, course completion reports and the final marks
- Discretization: As some machine learning algorithms cannot cope with continuous attributes like marks or time, discretization transforms a continuous attribute into a categorical attribute, taking only a few discrete values like pass/fail or on-time/late. And etc.

After the data was cleaned, it turned out to be 2GB of data, ready for the classification. The final field to be processed was set to predict pass/fail of a course for every specific student based on the features on the database. As Figure **3**3 shows the data was divided to 70-30 proportion. 70% of the data was set as training set and 30% was set as test set to evaluate the model. The model was built using apache Spark machine learning library with naïve Bayes and ensemble decision trees. Ensemble methods use multiple learning algorithms to obtain better predictive performance than could be obtained from any of the constituent learning algorithms.

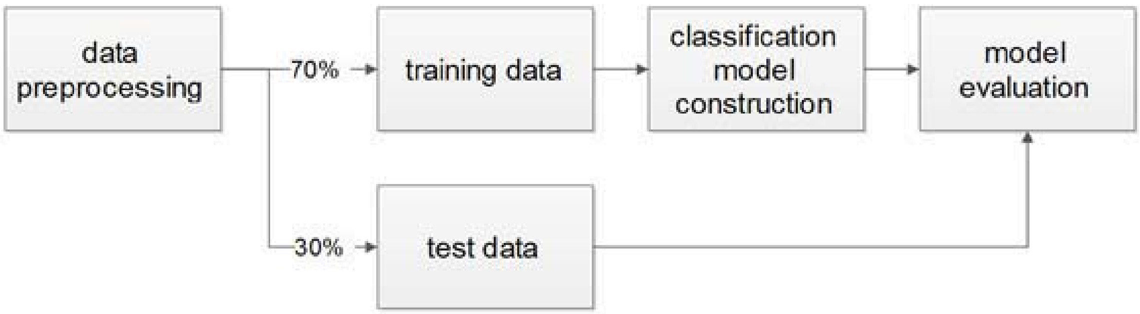


**Figure 3**: Classification and evaluation of eLearning data

The program was implemented in usual form using common fields like number of student's accesses, activities, views, connections, messages and etc. to predict the final status of every student: pass or fail. The final result had an acceptable accuracy at prediction task, but the runtime seemed to be growing exponential. So we used apache Spark special techniques to lower the run time of algorithm. Some techniques like persisting a set of data (RDD in Spark) on the cache of the system and broadcasting some variables to all distributed worker nodes of the cluster. Zaharia states if a large read-only piece of data is used in multiple parallel operations,

It is preferable to distribute it to the workers only once instead of packaging it with every closure. (Zaharia et al., 2010) . So Spark also lets Programmer create two restricted types of shared variables*, broadcast* and *accumulator*. If a large read-only piece of data is used in multiple parallel operations, broadcast types lets it to be distributed among the worker nodes only once instead of packaging it with every operation. Accumulators are variables that workers can only "add" and only the driver can read. They can be used to implement counters as in MapReduce.

When we wanted to count number of views of course pages for every student, in a simplified version of the problem we count the lines containing the text, “course module viewed” in a large log file stored in HDFS (Hadoop Distributed File System). This was implemented as follows:

```
val file = Spark.textFile("hdfs://...")
val views = file.filter(_.contains("course module viewed "))
val ones = views.map(_ => 1)
val count = ones.reduce(_+_)
```

First a distributed dataset called file as a collection of lines is created in HDFS. Then this dataset is transformed to create the set of lines containing “course module viewed” ,and then map each line to a 1 and add up these ones using reduce. The worker nodes receive ones in a streaming manner and perform a local reduce, actually sum all the local ones together and send their local counts to the driver.

Some of the variables like grades and student ID s are reused in different operations so a cached RDD was created from them too. Nodes would cache partitions of the cached RDD in memory after the first time they compute them. This speeded up subsequent operations on it. Cache, persist, accumulator and many other techniques of Spark were used in the program and reduced the runtime, so it is expected to see the same result for using these techniques on giant clusters too. These techniques will also reduce the network workload and rate of data transfer to the nodes because worker nodes will store the broadcasted data into their local storage.

## 5. Results

The data volume was set to be 16MB at the beginning and doubled in each stage to examine the runtime changes and track the differences of runtimes. After running the program we got three approaches to examine whether the proposed solution is efficient or not. In the first approach we ran the program on the apache spark engine not using any of the spark’s special techniques like persist and broadcast in the code. In the second approach we tried to use apache spark broadcast for specific parts of our data like student ID. RDDs which are more used in the iterations of the algorithm were supposed to be persisted so the medial RDD of cumulative count of students’ activities was persisted to cache. In the third approach we persisted to send all the initial RDD to the cache. Finally Figure **4**4 shows the final runtime results. It is perceived from the diagram that using Spark methods at the beginning with limited amount of data would not improve the run time but when the data becomes bigger the techniques will make more improvements and using spark methods make sense.

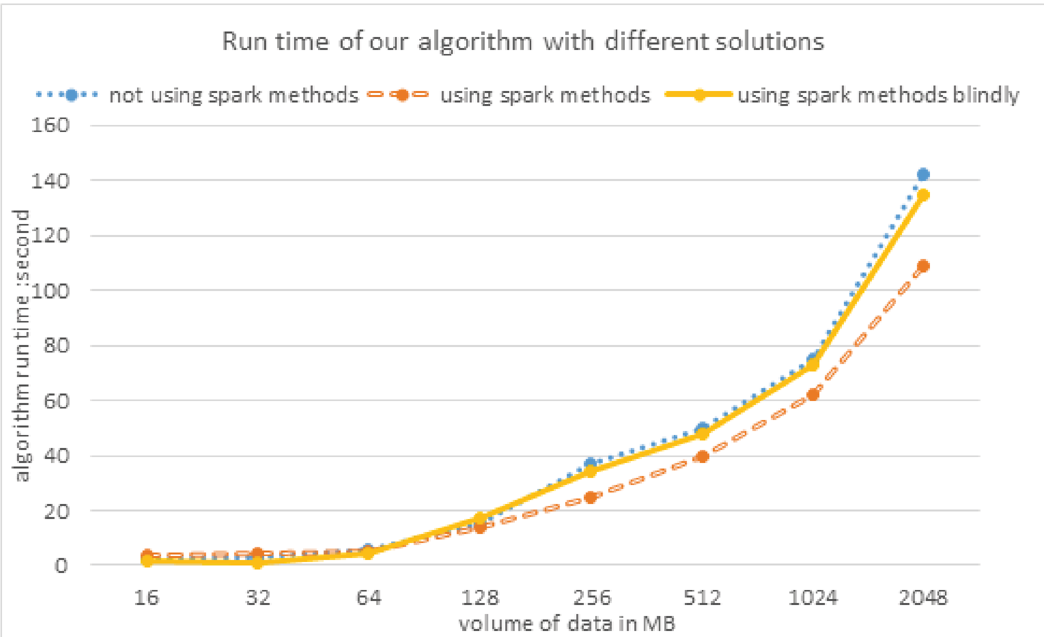


**Figure 4**: Run time of our predictive algorithm with different approaches

The results indicate that using apache spark is efficient by lowering the runtime using special apache spark techniques like persisting and broadcasting students ID and important features that are known only from eLearning point of view. And it also shows that using apache spark techniques without the realization of the eLearning dataset will not suffice to enhance the efficiency. The research is going to work on improving results and utilizing other apache spark machine learning methods specifically for the field of eLearning and learning analytics.

## 6. In conclusion

Similar to many other areas of technology and education, eLearning needs to seek outside its conventional boundaries for new solutions. Big data is the key point that will revolutionize the paradigms in eLearning. The present study accounts for a part of the author's M.S thesis which is going to continue to improve the accuracy of the classification algorithm and applying other techniques of Apache spark into the early warning process.

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# Using Anaglyphs in Descriptive Geometry

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**Abstract**: "The use of e-learning and modern technologies is an integral part of teaching descriptive geometry" (Rankowski and Minaruth, 1979). Teachers often create Flash animations, websites and other interactive materials for their students using special tools and software; e. g. Cabri, GeoGebra or Construct 3D (Garciá et al, 2007). All these materials should support development of spatial imagination. However, "this is the ability most students lack, which results in having problems with understanding simple tasks in descriptive geometry" (Gittler and Judith, 1998). Thus, Monge projection is not a favourite topic for them. This paper continues the article (Ferdiánová and Poruba, 2016), in which paper model of basic tasks in Monge projection, designed as supportive material for teaching geometry, were presented. The aim of the paper is to introduce interactive models for Monge projection, which are very easy to use in e-learning, as well as showing results from practical lesson in which they were used. Models of simple tasks were created in dynamic program GeoGebra, anaglyphs were used for better visualisation of geometric relationships in space. Results from practical lesson were processed with using basic statistical methods such as Wilcoxon test.

**Keywords:** Monge projection, Anglyphs, e-learning, spatial imagination

## 1. Introduction

Imagination is amazing and unique human ability, which is connected to creation of images, ideas and concepts. Molnár (2009) defines geometrical imagination as a set of abilities which relate to reproduction and anticipation, static and dynamic ideas about shapes, attributes and relations among geometrical figures in space. Slezáková (2011) argues that students have relatively underdeveloped geometric imagination. They understand some terms only formally and have disproportionate problems with solving geometric problems. This problem has many reasons. One of them is very little care we give to teaching geometry and geometric expression at all. On the other hand, there is lack of motivation of students as well as their dislike to this topic.

"Students have different dispositions to develop spatial and geometry imagination, the rate of development, however, depends on education and learning. We know three dimensional space very well, because this space is natural for us and it is about us. The ability to visualize spatial situations is not innate as given. It must be deliberately developed" (Ferdiánová and Poruba, 2016). One way of improving the imagination is the use of geometric models in teaching. Models are very often used in teaching Descriptive Geometry in the Architecture courses. "Descriptive Geometry for architects should provide basic information on the geometry of shapes as well as on projective methods" (Schmid-Kirsch, 1997). Schmid-Kirsch (1997) created models for Helical line on a cylinder, Clockwise and anti-clockwise corkscrew and so on for teaching DG at the Faculty of Architecture in Hannover University. He wanted to motivate students on lectures, when each topic was presented in different ways, so that all senses are involved, not only the brain. Schmid-Kirsch (1997) asserted of a conclusion, that the knowledge of various methods (traditional and new) gives the chance to select the most suitable one. Instead of presenting a large number of finished solutions, it is recommendable to reduce the number of treated problems and solve them step by step. This produces more independence, improves the sense of orientation and the problem solving strategies. Brahkage (2001) presented using WinCAG (Windows version of Computer Aided Geometry) in teaching Descriptive Geometry. Option tools and view aspects of WinCAG, which teacher can use in a lecture, were shown in the article. This application can contribute to didactical aid and to geometric spatial cognition. Vogt (2015) created a special e-learning course for students of Geometry and Engineering Graphics in AutoCAD. The e-learning course obtains a book of theory, tutorials, drafts for each of the covered topics, advantage of animations, instructional films and online quizzes. Pütz (2001) described using of didactic principles and shows effective methods demonstrated on examples of Monge projection in lecture Descritpive geometry for architects. The lecture was attended by about 250 students - he need use another teaching methods than me. He used excellent motivational example of a „tree house", which consists of a cuboid standing on one of its corners. Students constructed drawing in Monge projection and after that they built real paper model in teamwork.

All these approaches seem to be very enriching. Unfortunately, they have not been statistically tested yet - it cannot be statistically confirmed, which of these methods is more effective or brigs more benefits.

The excellent book for teaching Monge projection, in which 3D models of tasks are included, is Basic examples of descriptive geometry in models (in original Základní úlohy deskriptivní geometrie v modelech). Geometric shapes in Monge projection by Jakub Poruba is very similar bachelor thesis like the book Basic examples of descriptive geometry in models. We represented a few parts from this thesis on conference Aplimat 2016. The work contains 12 paper models of Monge projection with complete drawings and so on. Our aim is to introduce interactive models for Monge projection, which are very easy to use in e-learning, as well as to show results from practical lesson in which they were used. Models of simple tasks were created in dynamic program GeoGebra, anaglyphs were used for better visualisation of geometric relationships in space.

## 2. Anaglyph

Anaglyphic stereograms (anaglyphs) are stereo pairs of images in which each image is shown using a different colour. This method consists of printing two negatives which form the stereoscopic photograph in the same paper, one in blue (or green), one in red. Two-colour negative are created from two central projection images projected from the centres approximately 6.5 centimetres apart, which is the centre distance typically between human eyes. The viewer would then use coloured glasses with red (for the left eye) and blue or green (right eye). The left eye would see the blue image which would appear black, whilst it would not see the red; similarly the right eye would see the red image, this registering as black. Our brain then creates a three dimensional image and we would see the illusion in front of or in the paper, see Figure 1. This is an illusion in principle.

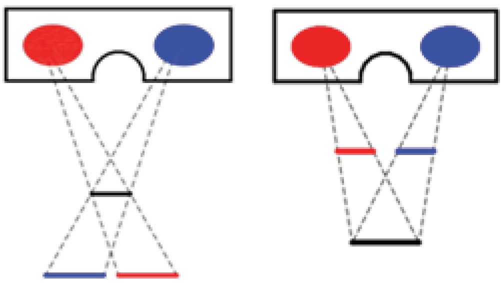

**Figure 1**: Orthoscopic (left) and pseudoscopic view (right)

Wilhelm Rollmann first illustrated the principle of the anaglyph using blue and red lines on a black field with red and blue glasses to perceive the effect in 1853, but this method was for line drawings only. In 1858, Joseph D'Almeida came upon a new way to view space based on the same principles. In this system, two images are created using two different lights, red and green/blue. By looking through the light filters, one achieves the 3D effect. The technical term for this technique was anaglyph. Alexandr Klein argues that the word anaglyph comes from the Greek anagluphos, meaning “wrought in low relief”; this comes from the word anagluphein, which means “to carve in relief” (ana = up + gluphein = to carve). Wiliam Friese-Green patented a camera/projector almost identical to Varley's stereoscopic model in 1893. He demonstrated film X-Rays and the first film was shown in Britain. Anaglyph films were very popular in the 1920s. Anaglyphic stereograms were used in education and science. For example the US Geological Survey has thousands 3D full-color images, which depict the geology and scenic features of the U.S. National Park system. Scientific images also include the presentation of complex multi-dimensional data sets and stereographic images of the surface of Mars by NASA. During the time, graphic designers have created anaglyph comics, movies, videogames and so on.

## 3. Didactic principles

When teaching, every teacher should respect so called didactic principles (sometimes called principles of teaching-learning process). These principles are general suggestions or rules which help education process to be as much effective and efficient as possible and should be followed not only in teaching but also in creating all supportive materials. Following principles are the most presented: principle of plasticity, consciousness and activity, adequacy, orderliness and feedback. Our brain receives 87 % of information via sight, 9 % via hearing and only 4 % are received through other senses (touch, smell and taste). In education process, verbal communication is used the most, but for teachers, it is also very important to try to illustrate as much information as possible. It is especially important in Mathematics, because students meet such a large ammount of abstract terms which they have to process.

Petty (2006) shows five main advantages of illustrating: drawing attention; change; support of understanding; easier remembering; showing interest of the teacher.

## 4. Special materials for Monge projection

We have created a collection of examples for Monge projection. Each example contains task, description of the construction, drawing, paper model and anaglyph version. Paper models and anaglyph version were created in application GeoGebra.  Assembling the model does not take more than 10 minutes and all what students need arescissors, a ruler and a glue. If we look at the model at eye level, it should be easier to understand the constructions in the drawing.  Anaglyph version of model is save in file of GeoGebra, student can open the file and they can move with model. It is still popular – because it is easy to make an anaglyph visualization setup. From the special equipment you need only red/blue glasses. We have saved all materials for our students in Moodle.

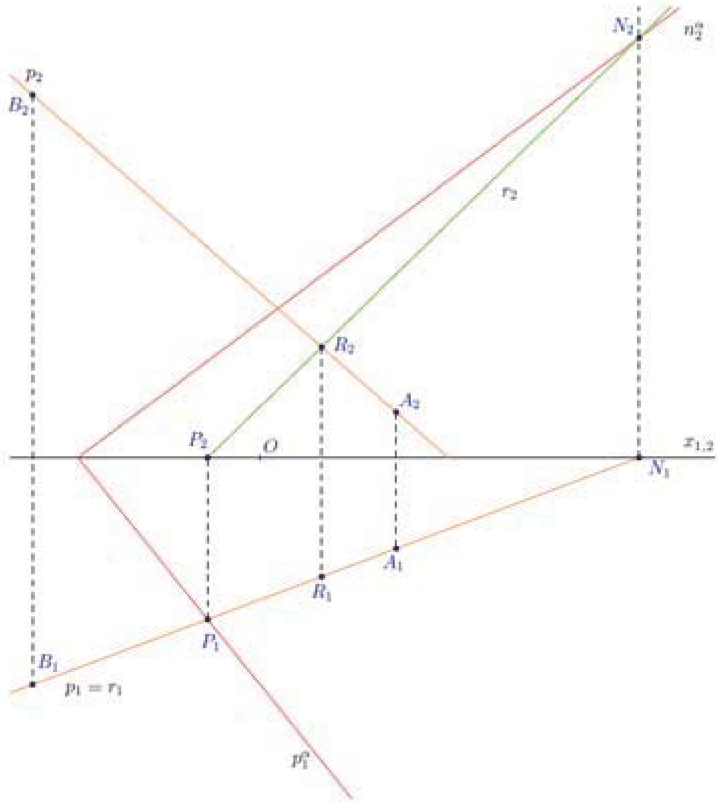


**Figure 2**: The drawing of the task Intersection of the plain and the straight line created by Jakub Poruba

The following example represents set of models that have been created so far.

The straight line $p$ is given by the points $A[3;2;1]$ and $B[-5;\ 5;\ 8]$ and the plain $\alpha(-4;5;3)$. Construct the intersection of the plain and the straight line.

The material contains detailed description of the construction for a drawing. Students are able to construct a drawing (see Figure 2) using the description of the construction without the help of the teacher. If they have a poor geometric imagination, they can assemble the paper model (see Figure 3). The last option is to use the anaglyph version of example (see Figure 4)

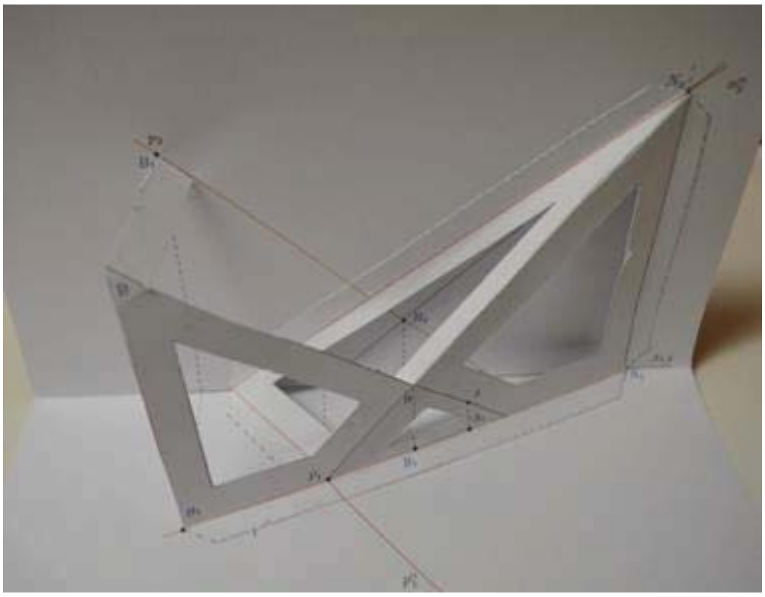

**Figure 3**: The paper model of task Intersection of the plain and the straight line photo by Jakub Poruba

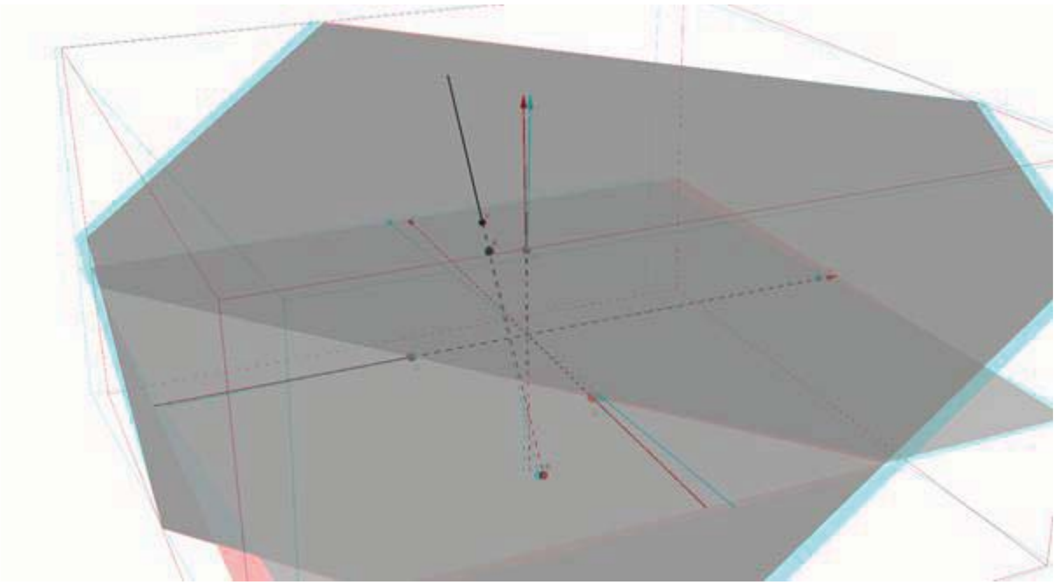

**Figure 4:** The anaglyph of the example

We used all materials in course on Constructional Geometry. Theoretical background and principles of working with these materials were introduced during the lesson and all needed materials were available for students during the particular lesson as well as after its end.

## 5. Pilot testing of materials

The Constructional Geometry course was introduced as an obligatory course for all bachelor degree programmes in combination with mathematics. The course contains these parts: Planimetric problems, properties of conics, fundamental stereometric problems, affinity and collineations, Affinity of a circle and ellipse, introduction to Monge projection, positional problems in Monge projection, Metric problems in Monge projection, solids in Monge projection. We can see Monge projection is 50 per cent of the course. In previous years, the success of solving problems in Monge projection of 50-60% for our students. We included new interactive materials for Monge projection to our course for this academic year.

A test and a questionnaire were created for students of Constructional Geometry. The test obtained three tasks on Monge projection with different levels of difficulty. The task 1 was focused on finding step of a plane, task 2 contained positional problems in Monge projection. Task 3 was focused on using affinity in construction; for example, student has to construct a square in general plane. The test was part of the standard test in summer terms 2015 and 2016. In total, 18 tests were distributed in 2015's group and 17 in 2016's group. In summer term 2016, students were sent an anonymous questionnaire through Google after that. This guaranteed anonymity of respondents and they answered the questions from the questionnaire truthfully, because students knew results of the test.

**Table 1:** Answers of respondents for the questionnaire

| | Yes | No |
|---|---|---|
| Paper models were useful | 88,24% | 11,76% |
| Assembling of models were difficult | 58,82% | 41,18% |
| Help you model for better understand Monge projection? | 82,35% | 17,65% |

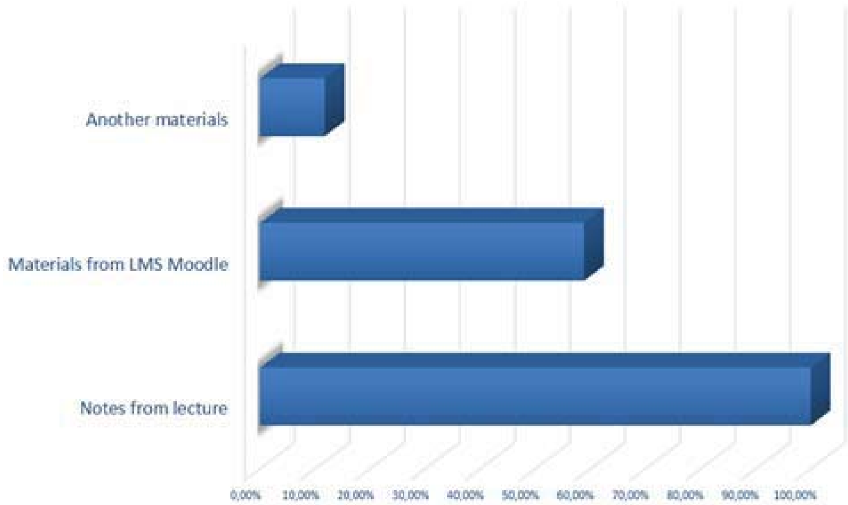


**Figure 5:** The graph of What materials did you use to prepare for an exam?

For students, standard lectures are still important, because they very often used their notes for preparation for an exam.  In our case, 100 % students used notes and same 59 % students used materials from LMS Moodle. Most of them didn't need to find and use another materials, only 12 % of students did it.

These days, in age of computer simulations, creation of paper models may seem as a "step back", but these models were very useful for our students. If we assembled these models in the lecture, students considered it very interesting and a climate of group was open and excellent. On the other hand, 59 % of students claimed that assembling the models was difficult for them. Most students feel that the use of these models led to better understanding of the Monge projection.

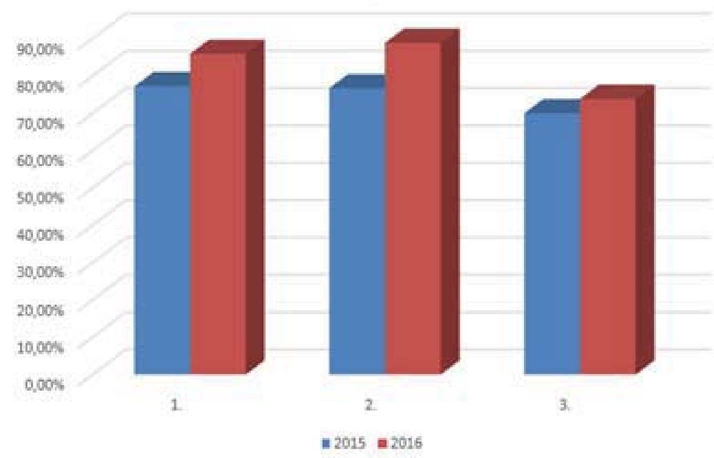


**Figure 6**: Average point achievement of students from Constructional Geometry 2015-2016

We set the test hypotheses that were tested on the acquired data using Wilcox test, because normality of data was rejected by Tests of Assumptions (Skewness Normality test and Omnibus Normality test). We used statistics application NCSS 8.0.

*Hypothesis 1.*

*Ho: Students from summer term 2015 and 2016 will acquire equal number of points from Task 1.*

*H1: Students from summer term 2015 and 2016 will not acquire equal number of points from Task1.*

**Table 2**: Wilcoxon (W) signed-rank test for difference in medians for task 1.

| | Approximation Without Continuity Correction | | | Approximation Without Continuity Correction | | |
|---|---|---|---|---|---|---|
| | Z-value | Prob. level | Reject H0 | Z-value | Prob. level | Reject H0 |
| Median <>0 | 3,7412 | 0,000183 | Yes | 3,7167 | 0,000202 | Yes |
| Median <0 | 3,7412 | 0,999908 | No | 3,7656 | 0,999917 | No |
| Median >0 | 3,7412 | 0,000092 | Yes | 3,7167 | 0,000101 | Yes |

We reject zero hypothesis and accept alternative hypothesis. Students from 2016 were better than students from 2015 in task 1, (Table 2). Their average point achievement increased by 8.66%, see Figure 6.

*Hypothesis 2.*

*Ho: Students from summer term 2015 and 2016 will acquire equal number of points from Task 2.*

*H1: Students from summer term 2015 and 2016 will not acquire equal number of points from Task 2.*

**Table 3**: Wilcoxon (W) signed-rank test for difference in medians for task 2.

| | Approximation Without Continuity Correction | | | Approximation Without Continuity Correction | | |
|---|---|---|---|---|---|---|
| | Z-value | Prob. level | Reject H0 | Z-value | Prob. level | Reject H0 |
| Median <>0 | 3,7412 | 0,000204 | Yes | 3,6898 | 0,000224 | Yes |
| Median <0 | 3,7412 | 0,999898 | No | 3,7383 | 0,999907 | No |
| Median >0 | 3,7412 | 0,000102 | Yes | 3,6898 | 0,000112 | Yes |

We reject zero hypothesis and accept alternative hypothesis. Students from 2016 were better than students from 2015 in task 2, (Table 3). Their average point achievement increased by 12,15%, see Figure 6.

*Hypothesis 3.*

*Ho: Students from summer term 2015 and 2016 will acquire equal number of points from Task 3.*

*H1: Students from summer term 2015 and 2016 will not acquire equal number of points from Task 3.*

**Table 4**: Wilcoxon (W) signed-rank test for difference in medians for Task 3.

| | Approximation Without Continuity Correction | | | Approximation Without Continuity Correction | | |
|---|---|---|---|---|---|---|
| | Z-value | Prob. level | Reject H0 | Z-value | Prob. level | Reject H0 |
| Median <>0 | 3,6346 | 0,000278 | Yes | 3,6109 | 0,000305 | Yes |
| Median <0 | 3,6346 | 0,999861 | No | 3,6584 | 0,999873 | No |
| Median >0 | 3,6346 | 0,000139 | Yes | 3,6109 | 0,000153 | Yes |

We reject zero hypothesis and accept alternative hypothesis. Students from 2016 were better than students from 2015 in task 3, (Table 4). Their average point achievement increased by 3,82 %, see Figure 6. This small increase is caused by a higher complexity of the task in comparison to previous ones.

## 6. Conclusion

Quality materials for self-study are an integral part of every teaching. The question is where the boundaries of the amount of generated materials are. We introduced the concept of materials for Monge projection here, especially on the materials of paper models and anaglyph models of the same tasks. For students, these materials are met with a warm welcome and are largely understood as refreshment of lecture. Respondents were students of course on Constructional Geometry. For testing, these students have a high inner motivation and this course is classified as very useful and necessary for their future work. After the pilot testing, we found out, that results of students were about 8 % better in comparison to previous year. It is also interesting, that these students did not meet the Monge projection in the previous study in high school. These results are motivation for us for our future work, because we would like to test the biggest group and would like to extend materials.

## Acknowledgements

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# Collaborative Environments in Software Engineering Teaching: A FLOSS Approach

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**Abstract**: Open development has emerged as a method for creating versatile and complex products through free collaboration of individuals. This free collaboration gathers globally distributed teams. Similarly, it is common today to view businesses and other human organisations as ecosystems, where several participating companies and organisations co-operate and compete together. As an example, Free/Libre Open Source Software (FLOSS) development is one area where community driven development provides a plausible platform for both development of products and establishing a software ecosystem where a set of businesses contribute their own innovations. Equally, open and informal learning environments and open innovation platforms are also gaining ground. While such initiatives are not limited to any specific area, they typically offer a technological, legal, social, and economic framework for development, relying always on people as open development would not exist without the active participation of them. This paper explores the participation of master students in FLOSS projects, while merging two different settings of learning: formal and open/informal education.

**Keywords**: free/libre open source software, software engineering education, participatory learning, community driven development, collaboration, formal learning, informal learning, open learning

## 1. Introduction

Open development has emerged as a method for creating versatile and complex products through free collaboration of individuals, and gathering distributed teams. Initiatives such as the Open Government Partnership (Open Government Partnership , 2008), the Open data (Open Knowledge International , 2009), or Free/Libre Open Source Software development (FLOSS) (Stallman, 2015) are becoming more and more prevalent.

FLOSS development is one example where community driven development provides a plausible platform for both development of products and establishing a software ecosystem where a set of businesses contribute their own innovations. While such initiatives are not limited to any specific area, they typically offer a technological, legal, social, and economic framework for development, relying always on people as open development would not exist without the active participation of them. There are several examples of FLOSS development with business impact that are very well know, and are used on a daily base worldwide. Among those examples we can name Wikipedia (Wikipedia Foundation, 2001), Firefox (Mozilla, 2002), or Thunderbird (Mozilla, 2004).

Current trends in education point out that learning results from participation in social interactions and in culturally organized activities with others (Palincsar, 2013). This shift of perspective raises a number of questions on the organization of the educational process, namely on its dynamics to provide suitable support with different degrees of formality. E-learning systems and e-learning supported infrastructures are certainly part of this debate. It has been pointed out that, “in the last 20 years, e-learning grew from a unique college experiment to a full category of higher education. In 2010, there were more people enrolled in online classes than the entire population of Wisconsin” (elearners, n/a). It is therefore legitimate to think of a fully personalized education system designed around needs, interests and aspirations of each learner. Moreover, with the emergence of Web 2.0, conventional e-learning systems, based on instructional packets and cumulative assignments, gives the stage to a different reality which promotes the concept of social learning through the use of social software tools, such as blogs, wikis, forums, etc. As a result, learning in a broad and heterogeneous perspective, occurs at a societal level through the development of complex interactions between peers. As such, living and working in a modern society requires observation, awareness and understanding how the social, economic, cultural, etc. environment is changing around us and how we tend to react to such changes. It requires willingness and ability to reflect upon, learn and eventually adapt to change (Free Management Library, 2016). This, in turn, is increasingly associated with continued learning. Continued learning is not about mere acquisition of content knowledge through formal courses. Instead, it is about building cross-cutting competencies and skills in reflection and inquiry, so that one’s life and work experience becomes a personal learning lab. Continued learning involves developing knowledge, skills and capabilities in conceptualizing and taking responsibility for one's own learning process; adapting the learning process to a variety of living and working situations; continually observing and analyzing one's own experience to draw conclusions and insights and to inform personal decisions; thinking holistically about our presence in a larger "system" and our experience as a reflection of this system; among others (European Commission, 2007). This new learning perspective is in contrast with a number of fundamental assumptions which have historically underpinned the organization of education: 1) expertise and knowledge resides only within the walls of the educational institution; 2) "learning" and "schooling" are different words for the same thing; 3) the most "equitable" educational systems are those which offer a "one-size-fits-all" approach, and 4) the easiest and most cost-effective approach to organizing learning is within the walls of the school.

This paper aims at making a concrete contribution to re-thinking educational practices in computer-oriented environments. Far away from the "school as a factory" metaphor, we envisage learning approaches for software engineering courses that, in sharp contrast with formal institutions and curricula, promotes the usage of informal learning mechanisms, promoting the "learning by doing" approach and that, ultimately, prepares students for the future. Therefore, this paper reports on exploring, through a concrete initiative, the participation of master students in FLOSS projects, while merging two different settings of learning: formal and open/informal education.

The rest of the paper is structured as follows. Section 2 presents the background. Section 3 describes the research methodology used to run the pilot project on collaborative education with master students. Section 4 presents the project and its finding. Section 5 concludes.

## 2. Background

Open development has emerged as a method for creating versatile and complex products through free collaboration of individuals. This free collaboration gathers globally distributed teams. As an example, Free/Libre Open Source Software (FLOSS) development is an area in which community driven development provides a plausible platform for both development of products and establishing a software ecosystem where a set of businesses contribute their own innovations. Equally, open and informal learning environments and open innovation platforms are also gaining ground. While such initiatives are not limited to any specific area, they typically offer a technological, legal, social, and economic framework for development, relying always on people, their skills, capacities and participation.

FLOSS communities consist of heterogeneous groups of independent volunteers, who interact even if driven by different motivations (Cerone, 2010). In such communities, volunteers collaborate, share their knowledge, by not only teaching but also by learning.

Learning, on the other hand, can be defined as a "persisting change in human performance or performance potential which must come about as a result of the learner's experience and interaction with the world" (Driscoll, 2005). It can be formal, i.e., institutionally framed and hierarchically structured, or informal.

Informal learning is a life-long process in which an individual acquires knowledge, attitudes, values and skills while performing daily activity within various contexts. From Jay Cross' perspective, "people informally acquire much of the knowledge they use in their practice. Through the observation of others, by trial and error, and simply working side by side with more experienced people". In his opinion, "formal education contributes only about 10% to 20% of what a person learns in a professional context" (Cross, 2006). In both settings, the qualifier collaborative refers to sets of activities involving a group of people learning or trying to learn something together. The term can be defined more broadly as collaborative teaching and learning (Elizabeth F. Barkley, 2004), as both activities occur together. Unlike individual learning, collaborative teaching and learning capitalizes on students' resources and skills. For example, individuals learn from each other and teach to each other by enquiring, debating, cross-assessing ideas between members and mutually monitoring work progress. Collaborative teaching and learning encourages knowledge construction, skill development and a deeper understanding by actively engaging students in the learning process.

Any collaborative teaching and learning agenda, as well as any technology enhanced learning framework, will be based on assumptions, implicit or explicit, concerning what it means to learn in collaborative settings.

The theoretical lens that guides our study is constructivist epistemology (Piaget, 1976), which emphasizes the agency of the learner in the learning process. Learning can only happen through the learner's efforts at producing meaning (in a broad sense, making sense of the world), although a mentor might help in providing challenging experiences in order to accelerate the process of change (Suthers, 2006).

## 3. Research methodology / case study

Our research is based on a pilot project in teaching and learning software engineering that has been carried out for 2 years. The first findings were reported in the following publications: "Integrating Formal and Informal Learning through a FLOSS-Based Innovative Approach Background: Learning as a Process" (Fernandes, 2013), "FLOSS Communities as Learning Networks" (Fernandes, 2013), and "A pilot project on non conventional learning" (Fernandes, 2013).

The research follows a participatory action research approach analysed through the construction of a case study. The pilot project involves students, who act both as participants - involving themselves in the activities carried out within the project, and as observers - reflecting about their own practices, behaviours and achievements exhibited and gained through their participation in the project. They are part of a class of pre-service teachers, i.e. students in the last year of a MSc course whose completion will entitle them to teach Informatics at secondary school level. As such, they seem highly motivated to analyse new learning experiences and even test them in their own classes. By definition, participatory action research aims to understand the "world" by trying to change it, collaboratively and reflectively. Rather than a strict method, it is an approach to what research actually means in Social Sciences and Education.

The pilot project aims at teaching students' software engineering skills through their involvement in a FLOSS project, using the open and democratic style typical of FLOSS communities. Students are proposed a list of FLOSS projects among which they can choose one to get involved in, but they are also free to choose a project not in the original list. How students get together in small groups (up to 3 elements) and which role each student and/or small group will play within the project are also free choices. Within each group, leadership may spontaneously emerge and either have an official recognition or just appear as part of the interaction activities. Along the case study, data is collected through a combination of direct observation during a 2 hours' weekly meeting, unstructured interviews and independent analysis of the work provided in the community by the instructor. Interpretation of direct observation allows us to gather information about the learning and communication skills of the students, their interaction and collaboration modalities, and how roles and leadership emerge from the collaborative process. Unstructured interviews provide a more complete picture of students' behaviour by investigating actions and tasks that are not directly observable and fostering the externalization of motivations and expectations. The analysis of each project as a participant by the instructor allows to better understand the dynamics of all participants in a certain project. All data collected is stored in the project collaborative platform hosted by Moodle, and maintained by the instructor. The weekly meeting of all groups with a member of the research team (instructor) allows a live interaction and smooths some difficulties in the project development, namely at the technical level.

## 4. Project launch and findings

This paper explores the participation of master students in FLOSS projects, while merging two different settings of learning: formal and open/informal education. To this aim we ran a project with master students, comprised by pre-service teachers. The project had the participation of 16 students during the first year and 21 students during the second year.

### 4.1 Project launch

The project had the duration of 1 semester in both years of the experiment.

In the first year the pilot was planned as followed: during an introductory meeting the project was presented, and each student filled a questionnaire aiming at 1) understanding the academic and professional background of each student and 2) if students were familiar with FLOSS and FLOSS projects, both as users and contributors. After presenting the objectives of the project and the questionnaire was filled, and students, between them, gathered as groups of no more than 3 elements. Since the class had been working together for more than a year – the first year of the master degree – it was easy for the groups to be gathered.

During the first meeting, students were introduced to the platform they were going to work with, Moodle. Using Moodle, students downloaded the list of FLOSS projects recommended for the project. Since it was a group work, each group had one week to study each project and choose the one that was more suitable for them. It was also allowed for each group to choose a project that was available on GitHub or Source Forge. Added to the list, the research team also decided roles to be performed in each project. The roles could be: analyst, expected to document the functionalities of the software; programmer, to develop and integrate code; and tester, to test the software developed.

Once each group decided on the project, they start the technical work, such as installing all the required tools, and planning their activities. All tasks were reported on a weekly basis on the platform highlighting all the achievements and difficulties faced during each week. Finally, the final part of the project required 1) the submission of the work done to the relevant FLOSS community of each project; 2) the presentation to the whole class and instructors the work done during the semester.

During the second year of the experiment, motivated by a students' request, checkpoints were introduced so that each group could present on-going work at different moments. This made easier for each group to stress its concerns and achievements; additionally, it helped instructors to follow the work.

### 4.2 Findings

From the questionnaire we found out that the students involved had, on average, a modest background when compared to typical programming skills of members of FLOSS communities. All of them, however, were aware of the FLOSS phenomena and knew (or, at least, have heard about) a number of open source projects: the majority mentioned Linux, Open Office, and/ or Mozilla. This first activity allowed us to define the profile of the students: modest background in software development, very interested to learn new teaching methods and curious about FLOSS development. This aspect was later confirmed by the roles they selected; typically students with less skills on programming decided to perform roles such as analysts.

All students –both from the first and second year - were involved in the project for nearly 5 months. In both experiments their global attitude was pro-active, namely in dealing with difficulties in establishing a connection with the chosen FLOSS community. It was clear that the main challenge of such project was to ensure an effective interaction with the relevant FLOSS community – if in some cases it was a smooth activity, in others students faced many difficulties and ultimately had to change to a different project. Another finding of the participation in FLOSS projects and their communities was that, despite some communities welcomed the participation of students, even if in some cases, the community was very slow to answer; in others the community had some difficulty in understanding what the group was proposing to do. Typically, the interconnection with the communities, usually through a leading person of the community, was set in a mutual understanding basis, and within 30 to 40 days. This number seems too high with respect to our expectations of a live interaction with "live" communities and it is clearly a factor that needs to be taken into consideration when planning similar projects.

The second problem faced by the groups has normally to do with project management. Once students disclosed they were going to contribute to the project and study the community for only 5 months, the project management of most projects was not so welcoming of the idea, as they normally do not enjoy short term contributions. As such, for the second year, the research unit requested students not to disclaim immediately the time they were going to contribute to the project and study the community.

Interestingly, during the second year and because some projects were the same as the previous year, some group integrations and dynamics went smoothly, naturally taking advantage of the previous acquaintance of the 1st year of the project.

As far as the group task division was concerned, and differently of what the research team was expecting, small groups were quickly able to specialize each member in a particular task. In groups of 3 students, typically one was designated to lead the interaction with the community, another assigned the technical task of downloading, installing and configuring the software (namely in the beta- version in which the community was active) and finally, other became in charge of documenting the whole process.

The daily supervision of the project platform (based on Moodle) allows us to say that all groups were active in using discussion groups, chats, emails, and forums to exchange ideas, doubts or achievements, using similar channels that are actually using in each FLOSS community. They even made a number of suggestions to the research team to improve the collaborative platform. During the first year, and by students' initiative, an informal workshop, in which each group presented their own experience, was planned as a project checkpoint. This initiative was then formally adopted for the following year.

From the weekly meetings and the reports, it was interesting to see the impact that the "learning by doing" brings to someone's learning process. If depending on a certain community participating in a FLOSS project may bring some delays – either contributors are not so interested in the project or they don't have too much time for tutoring – also pushes students to be more pro-active in their learning process. Ultimately, this was necessary as the work performed was used for course assessment purposes.

Another interesting finding of the 2 years' project concerns how their academic and professional background limited the choice of tasks. Students with a more multi-disciplinary background (even if with a big component of technology) tend to choose tasks such as analyst rather than developer or code analyst. The fact that most of the students already have a background of working, and some where already above 35 years old, we found that there are not so willing to "think out of the box" and tended to be more conservative. Also interestingly is that when pushed, for example by someone the group or an interaction with the relevant FLOSS community, students showed an effort to push their own boundaries. Interestingly, another fining of the project is that FLOSS project contributors are not willing to teach but rather to discuss ideas and problems and show that they know how to fix problems.

Overall the participation in FLOSS project was a positive experience for the students. From both years of the experiment we can report that there were groups that: 1) struggled with the community as they did not reply or were taking too much time to reply; 2) we very welcomed by the chosen FLOSS community; 3) the community only took them seriously after the first commit they actually made; 4) none of the groups had difficulties with their group partners (at least nothing was reported); 5) once the community saw they were seriously in their task, they pushed the group to do more tasks; 6) almost all students felt their work was valid and appreciated; 7) students with more difficulties in software engineering were able to identify exactly their weakness but also where and how they could contribute best.

Finally, and during the final presentations, it was interesting to see how students were proud of the work they did, saying that it was very interesting to see people from all over the world praising their work and motivating them to continue their contribution after the experiment was finished.

## 5. Conclusions

Current thinking on education, recognizes that fundamentally learning and development result from participation of students in social interactions and culturally-rich activities with other students, and that IT has the potential to mediate learning experiences and to support networked collaborative learning. Such principle drove our research to whether FLOSS-driven projects do provide an interesting setting to exercise "learning-by-doing" and, in general, autonomous and proactive approaches to learning. From the two years experiment we conclude that participating in FLOSS projects can be really helpful as students have the opportunity to contribute to software development in real time and with real impact, and move inside a challenging and open (often too open …) technological and social framework.

From our analysis we can conclude that participating in FLOSS projects have a positive impact and that its inclusion in Software Engineering curricula as a complement to the formal education should be seriously considered. A number of aspects, however, should be taken into account: 1) students participating in such projects need to have a good background in software development and programming skills, and 2) FLOSS communities should be regarded only as supporters as, in general, they are not willing to spend much time to teach but rather to assist in problems that may occur.

From the 2 years' project, we confirmed our initial intuitions: Software Engineering curricula should be revised to include informal learning experiences. Participation in FLOSS projects, with suitable mentoring, may be one such possibility. Indeed, as more general claims, we would like to put on the table, for further analysis, the following statements 1) expertise and knowledge do not reside only within the walls of the educational institution; 2) the most "equitable" educational systems are not those which offer a "one-size-fits-all" approach, and 3) the easiest and most cost-effective approach to organizing learning is not only within the walls of the school.

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# Collaborative Learning (Online) and the Role of Student Engagement in Higher Education

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**Abstract:** For each objective in higher education student engagement is a prerequisite. However, many of todays' 'mass' universities lack particularly engaged students. Further, collaborative learning, which is the essence of each learning process, has been neglected in education for decades. We argue that digital technologies can support and foster collaboration (online) which in turn advances student engagement. Over the last decades, technology has tremendously and unforeseeably reorganized the ways we live, communicate and learn. One of the most promising but also challenging aspects of this change is the social learning approach. Learning in a digital and connected age does not depend on individual knowledge acquisition, storage, and retrieval; rather, it relies on connected learning that occurs through engaged interaction with various sources of knowledge and participation in communities of common interest, social networks and group tasks. Since learning as such, collaborative learning and engagement are strongly influenced by social interactions, technologies like social media can be powerful pedagogical instruments. However, it is not completely evident which factors contribute to a successful collaborative and engaged learning scenario (online). There is still a lack of research concentrating on impacting factors that trigger collaboration and engagement supported by social media in higher education. In this paper we suggest that the functioning of the learning community is one important factor, which has an impact on collaborative learning (online) and subsequently on the level of student engagement. By drawing on the educational team climate inventory (TCI), this paper provides propositions how various factors from the TCI impact students' perceived collaborative learning, perceived learning online as well as their engagement behaviour. Data (N = 48) from a quantitative pre-test that was distributed with an online questionnaire, offer initial impressions for the proposed hypotheses. The results reveal for example that the alignment of goals and support for individual learning have a positive influence on perceived collaborative learning. This paper constitutes a foundation to provoke additional empirical research regarding antecedents that impact collaboration, learning online and engagement in higher education. Consequently, our intention is to analyse, how the positive dynamics of collaboration (online) can be used to engage students.

**Keywords**: collaboration, engagement, higher education, team climate inventory, social media, online learning

## 1. Introduction

Learning in a digital and connected age does not depend on individual knowledge acquisition, storage, and retrieval; rather, it relies on ubiquitous connectivity and connected learning that occurs through interaction with various sources of knowledge, including the Internet and learning management systems, as well as participation in communities of common interest, social networks and group tasks (Siemens, 2004). Web 2.0 and 3.0 are changing how students acquire and share knowledge and information (Loureiro, 2012), also because students are used to those tools, as for many of them they are part of their daily routines (Erkollar and Oberer, 2013). The exchange of ideas with social media makes both the process and the product socially constructed (Everson et al., 2013). As learning is strongly influenced by social interactions (Miller, 1986, Vygotskij, 1978), the interactive features technologies offer can be powerful pedagogical instruments to foster social interactions, and engagement, supporting the learning process (Bransford et al., 2000) and providing opportunities for learners to engage deeply with the learning material (Janssen et al., 2011, Järvelä et al., 2016).

Nonetheless, it is not completely evident which factors contribute to a successful collaborative learning scenario (online) and engaged students. There is still a lack of research as pinpointed by the special issue on student engagement in the journal *Learning and Instruction* (e.g., see Fredricks et al., 2016). Consequently, teaching and learning scenarios at universities have to be constructed in a way that provoke engaged knowledge sharing, exchange of ideas and of problem solving-approaches, critical discussions and reflections, for short: interaction.

The team climate inventory by Brodbeck and colleagues (2010) tries to capture the facets of a group and its possible consequences for the individual. We assume that the learning community climate has a significant influence on the student's (collaborative) learning, interaction as well as engagement activities.

Thus, the purpose of this paper is to analyse antecedents impacting students' collaboration (online) and engagement behaviour in higher education. The following research questions are addressed:

- Do the various facets of the team climate inventory influence perceived collaborative learning, perceived learning online and student engagement?
- How does perceived collaborative learning and learning online impact the student's engagement?

## 2. Role of collaborative learning (online) and student engagement for learning

Although definitions of collaborative learning are widespread and a clear definition of engagement is even missing, both constructs are regarded by researchers as well as practitioners as highly important for learning processes (Azevedo, 2015, Järvelä et al., 2016, Bruffee, 1984). However, there is still a lack of research combining both concepts. Engagement was mainly considered with regard to individual student engagement, neglecting the fact that it is a process which changes over time, and that is susceptible to interpersonal and collaborative influences. Thus, there might be collaborative engagement as well as engaged collaboration. Further, in collaborative settings, engagement is dynamically influenced by a variety of social and contextual factors (Brodbeck et al., 2010, Järvelä et al., 2010), especially the interactions between learners (Miyake et al., 2014). The higher the number of individuals involved in interactions or collaboration, the more complex engagement becomes.

### 2.1 Collaborative learning (online)

The importance of collaborative learning in higher education becomes obvious through a simple statement by Faulstich (2013, p. 179): No human is detached from a community; individuals depend on others. Individual development cannot be understood without reference to the social and cultural context within which it is embedded. Higher mental processes of individuals have their origin in social interaction, which play a fundamental role in the development of cognition (Marotzki, 2004). Nonetheless, "this includes the activities and mechanisms performed individually, since individual cognition is not suppressed in peer interaction. But, in addition, the interaction among subjects generates extra activities (explanation, disagreement, mutual regulation, ...) which trigger extra cognitive mechanisms (knowledge elicitation, internalisation, reduced cognitive load, ...). The field of collaborative learning is precisely about these activities and mechanisms." (Dillenbourg, 1999, p. 4). Hence, learning is a participatory and social process (Vygotskij, 1978, Miller, 1986) and learning situations are increasingly social and interactive in nature (Järvelä et al., 2016). Thus, it can be argued that interaction and collaborative learning are important components for the student's learning process (Brooks and Bippus, 2012).

Research shows that collaboration fosters positive learning outcomes (e.g., Koh and Lim, 2012). However, results from face-to-face collaboration are not directly transferable to an online collaborative setting due to diverging circumstances (Dillenbourg and Schneider, 1995) but are a valuable and ground-laying source of information. Core collaboration processes like sharing knowledge, knowledge co-construction (Bruffee, 1984, Mercer, 1994), common concept formation (Knezic et al., 2010) as well as the purposeful connection of individuals (Ellison et al., 2012) can be supported and fostered by technology, which additionally provides more flexibility.

Hung and Yuen (2010) reveal that the majority of students using social networking sites in class developed social connectedness and favourable feelings regarding their learning experiences. These positive learning experiences were highly related to the information-sharing feature and interactional function of social networking. A research by Khan et al. (2014) reveals that academic performance, perceived support from Facebook friends, higher order Internet skills as well as instrumental support from Facebook friends positively impact academic collaboration on Facebook. As suggested by Sinha et al. (2015), previous research in (computer-supported) collaborative learning suggests that there is a potential to promote deep-level engagement in students.

### 2.2 Student engagement

Although student engagement is a highly promising concept, engagement is one of the most widely misused and overgeneralized constructs found in educational, learning, instructional, and psychological sciences (see e.g., Fredricks et al., 2016). Student engagement can be defined as "the extent to which students actively engage by thinking, talking, and interacting with the content of a course, the other students in the course, and the instructor" (Dixson, 2015, p. 2). Engagement is regarded as a multidimensional construct consisting of behavioural, emotional/affective, and cognitive facets (see e.g., Fredricks et al., 2016, Salmela-Aro et al., 2016, Shernoff et al., 2016). The behavioural dimension relates to behaviours such as effort, participation, attendance and homework; the cognitive dimension is for instance associated with investment in learning, depth of processing whereas the emotional part refers to affect and emotions like interest, boredom and anxiety (Shernoff et al., 2016). Järvelä and colleagues argue that interaction in collaboration can be seen as a key characteristic of engagement; thereby, interaction covers the cognitive, emotional and behavioural dimensions of engagement, since it involves collaborative and responsive interaction between group members (Järvelä et al., 2016).

Important to note is that students 'are' not engaged or disengaged, since engagement is not a characteristic of an individual. Like many other psychological constructs, the degree of engagement depends on time and context (see e.g., Jang et al., 2016). One of these contextual factors is collaboration. Like with collaborative learning, social media can influence engagement. Junco and colleagues focus in their studies (2011, 2013) on the impact of Twitter usage. Experimental evidence is provided that Twitter can be applied as an educational mean not only to foster student engagement but it also puts lecturers into a more active and participatory role (Junco et al., 2011). A subsequent study on tweets underlines that faculty participation, integration of Twitter and requiring students to use Twitter are vital factors of improved outcomes in the course (Junco et al., 2013). Another study by Chen et al. (2010) reveals that there is indeed a positive relationship between the usage of learning technology, student engagement and learning outcomes. Summing up, we assume that collaboration can be regarded as an essential part of engagement and social media in this context facilitates interaction and connectivity among the participants.

## 3. Team climate inventory

Brodbeck et al. (2010) developed the construct *team climate for individual learning* (TCI) that analyses group level functioning with respect to individual learning benefits. They assume that the team's climate for learning defines to which extent group members benefit from group work in their individual learning outcomes. Hence, the team climate inventory predicts how the individual student profits from working with others in groups. We assume that the TCI is an important framework for successful collaboration as well as for engagement that has not yet been respected in research so far. These assumptions go in line with Friend and Cook (1990) who argue that a mutual goal, parity among participants, shared participation, shared accountability, shared resources and voluntariness are necessary preconditions for collaboration to succeed.

Hence, for the purpose of this paper we assume that the nine defined dimensions of the TCI (regular contact, mutual trust, open exchange, support for individual learning, team management, goal alignment, motivation and interest, democracy and attendance) have a significant impact on students perceived collaborative learning and learning online. Respectively, we suggest that the TCI significantly affects student engagement. The following hypotheses are proposed:

***Regular contact*** concentrates on whether meetings, exchange and discussions take place regularly or not. We assume that

- H 1 a/b) Regular contact positively impacts the student's perceived collaborative learning respectively learning online.
- H 1 c) Regular contact positively impacts student engagement.

***Mutual trust*** is an important prerequisite for interpersonal relationships and therefore, we regard it as an essential component in our model and suggest that

- H 2 a/b) High levels of mutual trust positively influence the student's perceived collaborative learning respectively learning online.
- H 2 c) High levels of mutual trust positively influence student engagement.

***Open exchange*** refers to the extent to which opinions of the team members are respected. Hence, we suggest that

- H 3 a/b) Open exchange positively influences the student's perceived collaborative learning respectively learning online.
- H 3 c) Open exchange positively influences student engagement.

***Support for individual learning*** reflects the extent to which individuals receive support for their individual learning activities. Hence,

H 4 a/b) High levels of support for individual learning positively impact the student's perceived collaborative learning respectively learning online.
H 4 c) High levels of support for individual learning positively impact student engagement.

***Team management*** is about the structure and organisation of the group.

H 5 a/b) Successful team management positively impacts the student's perceived collaborative learning respectively learning online.
H 5 c) Successful team management positively impacts student engagement.

***Goal alignment*** tackles to which extent aims are clearly defined and communicated.

H 6 a/b) High levels of goal alignment positively impact the student's perceived collaborative learning respectively learning online.
H 6 c) High levels of goal alignment positively impact student engagement.

***Motivation and interest*** is concerned about how motivated and enthusiastic team members are.

H 7 a/b) High levels of motivation and interest positively impact the student's perceived collaborative learning respectively learning online.
H 7 c) High levels of motivation and interest positively impact student engagement.

***Democracy*** measures by whom the group is dominated**.**
H 8 a/b) High levels of democracy positively influence the student's perceived collaborative learning respectively learning online.
H 8 c) High levels of democracy positively impact student engagement.

***Attendance*** tackles absenteeism of group meetings.

H 9 a/b) Low levels of attendance negatively influence the student's perceived collaborative learning but have a positive effect on perceived learning online.
H 9 c) Low levels of attendance negatively impact student engagement.

Finally, we assume that

H 10 Perceived collaborative learning respectively perceived learning online have a positive effect on student engagement.

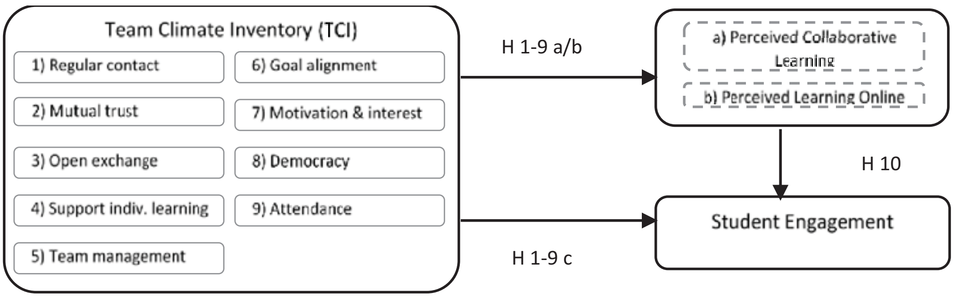


**Figure 1:** Conceptual model

## 4. Pre-test

***Measurements.*** We adapted eight items from Top (2012) to measure *perceived collaborative learning* and additional seven items to measure *perceived learning in an online context*. Further, we applied the *educational team climate inventory* from Brodbeck and colleagues (2010). Each item was measured with a 7-point Likert type-scale ranging from strongly agree (7) to strongly disagree (1). Finally, we borrowed two measurement items from Handelsmann et al. (2005) to measure *global student engagement (1=not engaged at all to 7=highly engaged)*. Further details can be found in **Table 1**.

***Sample.*** Forty-eight students from an Austrian and a Portuguese university participated in the pre-test (twenty-two females and twenty-six males; average age 29.46 years) which was distributed via an online questionnaire. We asked the participants which social media tools they use in addition for the course. The following results were reported: Moodle was used 75 % followed by Facebook (used by 56.2 %). 25 % used Skype and Learning Catalytics and 22.9 % Doodle. The least applied tools were Twitter, SnapChat, GoogleHangout, Pinterest, Lync/Skype for business, Adobe Connect and Instagram.

**Table 1:** Descriptive statistics

| | Min. | Max. | Mean | Std. Deviation | Cronbach Alpha |
|---|---|---|---|---|---|
| Perceived collaborative learning | 1.75 | 7 | 4.823 | 1.357 | 0.883 |
| Perceived learning online | 2.14 | 7 | 5.351 | 1.115 | 0.835 |
| Global Student Engagement | 3.00 | 7 | 5.396 | 0.945 | 0.639 |
| ***Team Climate Inventory*** | | | | | |
| Mutual Trust | 1.60 | 7 | 5.142 | 1.440 | 0.876 |
| Goal Alignment | 3.83 | 7 | 6.000 | 0.826 | 0.791 |
| Attendance | 1.00 | 7 | 4.854 | 2.163 | 0.885 |
| Regular Contact | 1.00 | 7 | 4.464 | 1.649 | 0.916 |
| Democracy | 1.00 | 7 | 5.354 | 1.627 | 0.838 |
| Team Management | 1.33 | 7 | 4.910 | 1.810 | 0.842 |
| Support for Individual Learning | 1.50 | 7 | 4.453 | 1.689 | 0.903 |
| Open Exchange | 4.00 | 7 | 6.201 | 0.893 | 0.883 |
| Motivation and Interest | 1.50 | 7 | 4.932 | 1.625 | 0.941 |

## 5. Results

We conducted four multiple regression analyses with perception of collaborative learning, perceived learning online and global student engagement as the dependent variables. The first two analyses look at the impact of the team climate inventory (TCI) on perceived collaborative learning and perceived learning online (H1-9a/b), the third regression analysis investigates the impact of the TCI on student engagement (H1-9c) and finally, we analyse if there is an impact of perceived collaborative learning and perceived learning online on global student engagement (H10).

**Table 2:** Regression analysis (dependent variable - perceived collaborative learning)

| | Standardized Coefficients | | | 95 % Confidence Interval | |
|---|---|---|---|---|---|
| Model | Beta | t | Sig. | Lower Bound | Upper Bound |
| (Constant) | | -0.129 | .898 | -1.632 | 1.436 |
| Mutual Trust | 0.173 | 1.496 | .143 | -0.058 | 0.384 |
| **Goal Alignment** | **0.188** | **2.445** | **.019** | 0.053 | 0.564 |
| Attendance | -0.094 | -0.924 | .361 | -0.187 | 0.070 |
| **Regular Contact** | **0.194** | **1.751** | **.088** | -0.025 | 0.344 |
| Democracy | -0.040 | -0.644 | .524 | -0.139 | 0.072 |
| Team Management | 0.003 | 0.027 | .979 | -0.156 | 0.160 |
| **Support for Individual Learning** | **0.457** | **3.224** | **.003** | 0.137 | 0.598 |
| Open Exchange | -0.037 | -0.458 | .650 | -0.301 | 0.190 |
| Motivation and Interest | 0.165 | 1.322 | .194 | -0.073 | 0.349 |

Team climate inventory accounts for 89.1 % of the variation in perceived collaborative learning ($R^2 = 0.891$).

The Durbin–Watson statistic is 1.709 and thus between the range of 1 to 3, meeting the requirements of independent errors (see e.g., Field, 2013). In order to assess the assumption of no multicollinearity, we checked the VIF values, which are well below 10, as well as the tolerance statistics, which are all above 0.1, indicating no collinearity within our data. Additionally, we checked the histogram and normal probability plot of the residuals which reveal that the assumptions of linearity and homoscedasticity are met.

The regression analysis reveals positive significant effects of *goal alignment* $\beta = 0.188$ (t(38) = 2.445, $p < 0.05$) as well as *support for individual learning* $\beta = 0.457$ (t(38) = 3.224, $p < 0.05$). Furthermore, we can report a weak significant effect of *regular contact* on perceived collaborative learning $\beta = 0.194$ (t(38) = 1.751, $p < 0.1$). For further details see Table 2.

Team climate inventory accounts for 60.5 % of the variation in perceived learning online ($R^2 = 0.605$). The Durbin–Watson statistic is 2.021 and thus between the range of 1 to 3, meeting the requirements of independent errors (see e.g., Field, 2013). In order to assess the assumption of no multicollinearity, we checked the VIF values, which are well below 10, as well as the tolerance statistics, which are all above 0.1, indicating no collinearity within our data. Additionally, we checked the histogram and normal probability plot of the residuals which reveal that the assumptions of linearity and homoscedasticity are met.

The regression analysis reveals again a positive significant effect of *goal alignment* $\beta = 0.391$ (t(38) = 2.673, $p < 0.05$). Further, *attendance* $\beta = -0.394$ (t(38) = -2.041, $p < 0.05$), *regular contact* $\beta = 0.571$ (t(38) = 2.708, $p < 0.05$) as well as *motivation and interest* $\beta = 0.643$ (t(38) = 2.705, $p < 0.05$), have a significant effect on perceived learning online. For further details see Table 3.

**Table 3**: Regression analysis (dependent variable - perceived learning online)

| Model | Standardized Coefficients | t | Sig. | 95 % Confidence Interval | |
|---|---|---|---|---|---|
| | Beta | | | Lower Bound | Upper Bound |
| (Constant) | | 0.469 | .642 | -1.846 | 2.958 |
| Mutual Trust | -0.187 | -0.848 | .402 | -0.491 | 0.201 |
| **Goal Alignment** | **0.391** | **2.673** | **.011** | 0.128 | 0.929 |
| **Attendance** | **-0.394** | **-2.041** | **.048** | -0.405 | -0.002 |
| **Regular Contact** | **0.571** | **2.708** | **.010** | 0.098 | 0.675 |
| Democracy | 0.155 | 1.304 | .200 | -0.059 | 0.271 |
| Team Management | -0.038 | -0.193 | .848 | -0.272 | 0.224 |
| Support for Individual Learning | -0.315 | -1.166 | .251 | -0.569 | 0.153 |
| Open Exchange | -0.009 | -0.061 | .952 | -0.396 | 0.372 |
| **Motivation and Interest** | **0.643** | **2.705** | **.010** | 0.111 | 0.772 |

Next, we analysed the impact of the *team climate inventory* on *global student engagement*. Team climate inventory accounts for 43.1 % of the variation in global student engagement ($R^2 = 0.431$). In this case, the Durbin–Watson statistic is 1.526 and between the range of 1 to 3 meeting the requirements of independent errors (Field, 2013). Again, the VIF values are well below 10 and the tolerance statistics are all above 0.1., indicating no collinearity. Also the histogram and normal probability plot of the residuals reveal that the assumptions of linearity and homoscedasticity are met.

The regression analysis reveals a weak significant effect of *motivation and interest* $\beta = 0.563$ (t(38) = 1.974, $p < 0.1$) as well as weak negative effects of *democracy* $\beta = -0.246$ (t(38) = -1.723, $p < 0.1$) and *mutual trust* $\beta = -0.502$ (t(38) = -1.896, $p < 0.1$). See Table 4.

**Table 4**: Regression analysis (dependent variable - global student engagement)

| Model | Standardized Coefficients | t | Sig. | 95 % Confidence Interval | |
|---|---|---|---|---|---|
| | Beta | | | Lower Bound | Upper Bound |
| (Constant) | | 4.963 | .000 | 3.545 | 8.430 |
| **Mutual Trust** | **-.502** | **-1.896** | **.066** | -.681 | .022 |
| Goal Alignment | -.194 | -1.102 | .277 | -.628 | .185 |
| Attendance | .244 | 1.055 | .298 | -.098 | .312 |
| Regular Contact | .328 | 1.298 | .202 | -.105 | .482 |
| **Democracy** | **-.246** | **-1.723** | **.093** | -.310 | .025 |
| Team Management | -.266 | -1.114 | .272 | -.391 | .113 |
| Support for Individual Learning | .143 | .442 | .661 | -.287 | .447 |
| Open Exchange | .083 | .456 | .651 | -.303 | .479 |
| **Motivation and Interest** | **.563** | **1.974** | **.056** | -.008 | .663 |

Finally, we checked whether or not perceived collaborative learning as well as perceived learning online have an impact on global student engagement. The Durbin–Watson statistic is 1.663 and between the range of 1 to 3 meeting the requirements of independent errors (Field, 2013). The VIF is well below 10 and the tolerance statistic above 0.1., again indicating no collinearity within our data. Additionally, the assumptions of linearity and homoscedasticity are met. The step-wise regression analysis reveals for the first model a positive significant effect of perceived learning online on *global student engagement* $\beta = 0.344$ ($t(46) = 2.485$, $p < 0.05$); however, for the second model (including perceived collaborative learning as well as perceived learning online) no significant effects can be reported.

## 6. Discussion

This paper shows the results of a pre-test, that lays the ground for a larger data collection to analyse, if the TCI impacts perceived collaborative learning, perceived learning online and student engagement.

The empirical data is only a pre-test, however, we found already some indications that the educational team climate has a significant impact on perceived collaborative learning, perceived learning online and student engagement. However, we pinpoint that, due to the small sample size of the pre-test data, we cannot generalize the results. As mentioned, we present in this paper a first notion of possible indications. Furthermore, we concentrate on a limited number of antecedents included in the model.

To sum up, we found as proposed, indications that goal alignment, regular contact and support for individual learning have a positive influence on perceived collaborative learning. Additionally, we can report that in line with our expectations, goal alignment, regular contact, motivation and interest as well as low levels of attendance have a positive impact on perceived learning online. Next, as hypothesized, student engagement is positively impacted by motivation and interest. Nonetheless and against our expectations, the pre-test shows that democracy and mutual trust have a negative impact on student engagement. These results provide valuable information for further investigations with larger data sets. However, the pre-test also gives indications that perceived learning in an online context has a positive impact on student engagement.

## 7. Conclusion, limitations and future research directions

This paper analyses factors that impact perceived collaborative learning, perceived learning in an online context and student engagement in higher education. By referring to the research questions, we found indications that team climate has an impact on perceived collaborative learning, perceived learning online and student engagement. Hence, the functioning of the learning community is indeed a vital factor for student engagement. Further, we can report that perceived learning online impacts student's engagement.

Several practical implications could be derived from the results of this pre-test: First, since goal alignment seems to have a positive effect on perceived collaborative learning, the importance of defining thorough learning aims according to learning taxonomies (e.g., Krathwohl, 2002, Biggs, 1999, Biggs and Tang, 2011) becomes even more evident. Our result also goes in line with the findings of Friend and Cook (1990), that mutual goals are an important preconditions for collaboration. Second, as there might be a need of support for individual learning, lecturers could use peer-reviews, peer-feedback or tutoring-systems, if individual support for each student is not possible due to huge classes. Further, as the results show motivation and interest is a trigger for several dependent variables. Hence, once more, the importance of motivating students as well as to foster their interest, curiosity and enthusiasm for the topics becomes evident. The more motivated lecturers are, the better they can contribute to the students' motivation.

As already mentioned, the underlying data constitutes a pre-test with all its limitations. Additional data collection is necessary. As mentioned, we present in this paper first assumptions of possible indications. Furthermore, we concentrate on a limited number of antecedents included in the model. Other triggers like personality traits (e.g. Big Five) are of interest and should be taken into account in future studies. Additionally, it would be necessary to evaluate the type of collaborative activity and compare these activities, since the influence of collaboration on engagement is a complex phenomenon. Moreover, the circumstances of the collaborative setting should also be taken into account. Those factors are for instance group size, adequacy of the task for collaboration (not every task is suited for collaborative learning and work) as well as the mixture of face-to-face and online settings. Finally, it has to be mentioned that even very motivated students are not able to be engaged all the time. Future research should take those aspects into account.

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# Why do Higher Secondary Students Like Cooperation but Reject Collaboration in an Online Environment?

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**Abstract**: The purpose of this case study was to investigate the impact of online learning tools on students' attitudes to cooperation and collaboration within a short-term out-class project. After a successful implementation of cooperation into a classroom based learning environment, our aim was to explore students' learning behaviour and strategies while working in teams on an out-class project in CLIL Social Science lessons. The project included both cooperative and collaborative activities dealing with the financial literacy. For our purposes we chose the environment of wikis (wikispaces.com) as it is an excellent tool for sharing information and building common knowledge. Furthermore, wiki projects can promote the 21st century learning skills (very often called 4 C's) such as critical thinking, creative thinking, communicating and collaborating. Before the experiment, we had to carefully select and define the collaborative skills, which our students were to learn and practise, since collaborative skills might vary into complexity and difficulty depending on the age of the class. The methods of questionnaire and focus-group reflection were used to analyse the contributions from 88 students. At first, the study researches both terms of cooperation and collaboration in an online environment, then the out-class project is outlined. Finally, the study presents the outcomes and findings and provides the close insight into team out-class learning. The study reveals that majority of students are able to cooperate in an on-line environment, however, if we look deeper, it is evident that the rate of cooperation varies a lot depending on attributes such as e.g. student's motivation, learning preferences, their relationships or leader skills. On the other hand, the study points out difficulties the students might have in online collaboration. These findings might be of interests to higher secondary teachers, who are engaged in out-class projects or intend to implement online technologies in teamwork.

**Keywords**: online cooperation, online collaboration, out-class project, motivation, team skills

## 1. Introduction

To engage team work in an everyday teaching and learning process has become a routine in the past ten years. Good team skills including collaborative skills are increasingly important in today's working environments. Moreover, being able to cooperate and collaborate in a working online environment seems to be a soft skill, which plays a crucial role if graduates fit and stay in a new (sometimes their first) job. We think that the higher secondary education level can help to make work team players from students. Ideally someone, who encourages teamwork, uses collaborative skills to benefit all involved parties while participating in a group.

The constructivist theory suggests that meaningful learning is dependent on a rich and relevant context of student centred and active learning. West and West (2009, pp 22) support the idea, that "contextual teaching and learning engages students in significant and relevant activities" that help them connect their higher secondary learning to real-life situations and problems. Further they point out that "A wiki project can provide tools and the collaborative work space that enable contextual teaching and learning." Before planning any wiki projects we should reflect learning attitudes of adolescent students at the age 15 to 19, as they may be seen as problem students. "Adolescence is bound up, after all, with a pronounced search for identity and a need for self-esteem; adolescents need to feel good about themselves and valued." (Harmer, 2009, pp 83). Adolescent students:

- prefer to express themselves visually and through a variety of media, on the other hand text literacy and writing skills seem to be less developed,
- expect constant and reliable access to friends, information, learning and support,
- often multitask, leaving one task for another,
- enjoy exploring new tools and learning by doing,
- like responding with their own thoughts and experiences
- prefer doing to reflecting,
- are open about themselves, their opinions and emotions,
- are vulnerable to the negative judgements of their own age group

- prefer more structured learning environments,
- have a strong preference for structure and pragmatism over ambiguity,
- expect guidance,
- are generally more social and engage peers to gain deeper understanding and approval, based on West and West (2009) and Harmer (2009).

Apart from taking into consideration adolescents' learning attitudes, we should pay attention to motivation. In the class a teacher can more or less encourage students' inner and outer motivation for teamwork by adjusting settings, modifying goals, helping to overcome difficulties, eliminating bad behaviours and judgements etc. "The attitude of a student's peers is also crucial: if they are critical of the subject or activity, a student may lose any enthusiasm they once had for learning "any subject (Harmer, 2009, pp 99). To prevent students from losing initial motivation to work in an online environment and encourage successful online cooperation and collaboration, several steps should be followed. At first, a teacher should be assured, that students are able to use cognitive skills. According to West and West (2009, pp 27-28) cognitive skills include *writing and constructive editing skills* (to be able to write, delete and edit and to be aware of appropriateness of editing), *web skills* (to be able to access the internet, to use web browsers, work with digital images and other web media), *group process skills* (set goals, communicate clearly, share leadership, participation, power and influence; make effective decisions or negotiate conflicts). Secondly, a teacher should focus on personal characteristics of each team member and promote the desirable ones for online team work. West and West (2009, pp 28-29) state these characteristics: *openness* (to be open to others' modifying, reorganizing and improving their contributions), *integrity* (represents accountability of each student, honesty of each student and competence of each student's contribution), and *self-organization* (to be able to see and adjust your own behaviour in relation to your environment, which requires metacognition, self-assessment and to be able to adjust to environmental feedback). Self-organization characteristics partially represent collaborative skills. Finally, a teacher should follow a basic instructional design process as it is outlined in e.g. West and West (2009, pp 31):

- *Define the wiki project's purpose.*
- *Classify the wiki project's learning domain.*
- *Define the wiki project's desired outcomes.*
- *Frame the wiki.*
- *Kick off the project.*
- *Develop group roles and ground rules.*
- *Determine assessment measures. More details in (West and West, 2009).*

To involve higher secondary students into online cooperation or collaboration includes careful planning and comprehensive preparation and yet there are so many variables, which can spoil it.

## 2. Cooperative and collaborative learning

The learning group is a group of students, which very often starts "with no formal leadership structure… Members of a learning group are typically peers in a class with fairly equivalent levels of expertise and knowledge in the topic area. …While learning groups are often project oriented (i.e., members are jointly producing a final product as their deliverable), the primary goal is individual learning and not just the quality of the final product." (Graham and Misanchuk, 2004, pp 185). The individual learning in this definition represents collaboration. On the other hand, the same authors characterize the work group as a group with "hierarchical leadership structure and clear role definitions. …Group members take on tasks that reflect skills and strengths already required. …collaboration occurs in defining how individual pieces of the design interface with each other, but work is specialized and done individually by those with particular expertise." (2004, pp 184-185).

The research of literature in this area provides the evidence "that researchers and practitioners writing about online collaborative learning are often writing about online cooperative learning, and vice versa." (McInnerney and Roberts, 2004, pp 204). Both McInnerney and Roberts try to find the similarities and differences between both learning. They suggest that "Collaborative is an adjective that implies working in a group of two or more to achieve a common goal, while respecting each individual's contribution to the whole,…and cooperative is an adjective meaning to work or act together as one to achieve a common goal, while tending to de-emphasize the input of individuals." (2004, pp 205) Based on their research they also state "that the term collaborative should be used for those learning techniques that emphasize student-to student interaction in the learning process, while the term cooperative should be used where students are required to work in small groups, usually under the guidance of the instructor." (2004, pp 207). "The communicative model of collaborative learning (CMCL) is based on three assumptions, according to Cecez-Kecmanovic and Webb (2000a): first, that collaborative learning is enacted and mediated by language; second, that collaborative learning involves processes of social interaction and third, that acts of communication or language acts function as social interaction mechanisms through which collaborative learning and knowledge co-creation processes may be produced." (Treleaven, 2004, pp 171). Stahl, Koschmann and Suthers (2006, pp 411) discuss the methods for studying cooperation and collaboration. "Learning in cooperative groups is viewed as something that takes place individually-and can therefore be studied with traditional conceptualizations and methods of educational and psychological research … the collaborative negotiation and social sharing of *group meanings* – phenomena central to collaboration – cannot be studied with traditional methods." With the rapid development of synchronous and asynchronous online tools the learning can be taken out of class. "The anywhere-anytime characteristics and its potential to support interactive group learning have convinced many educators to believe CSCL (computer-supported collaborative learning) environments" (Krejins, Kirschner and Jochems, 2002) can become tools for distance or home learning. "In online collaborative learning, students learn primarily by communicating among themselves via the Internet. In online cooperative learning, students are allocated to, and learn in, small groups and communicate within those groups via the Internet." (McInnerney and Roberts, 2004, pp 211). An online environment not always provides good results for collaboration "…virtual collaboration offers some challenges to the collaborative procedure that are not present in groups working in physically and communication among members is by definition mediated-and might be moderated…it can also remove the need for accountability…"(Graham and Misanchuk, 2004, pp 188). On the other hand, there are plenty of examples of good practice of implementing e.g. wiki technology in learning processes, more in (Su and Beaumont, 2014, and Larusson and Alterman, 2009).

## 3. A case study - methodology

To learn more about students' attitudes and experience in online cooperative and collaborative environments, we conducted a case study of cooperative and collaborative learning groups in a short-term out-class project. The project included both online cooperative and collaborative activities dealing with the financial literacy. For our purposes we chose the environment of wikis (wikispaces.com) as it is an excellent tool for sharing information and building common knowledge.

The main aim of this study was to explore students' learning behaviour and strategies while working in teams on an out-class project in CLIL Social Science lessons. The second aim of this study was to carefully select and define the collaborative skills, which the students were to learn and practise, and analyse attributes which influence the teamwork in both positive and negative ways. The study thus sought the answer for the question:

- What are the students' attitudes and experience to cooperation and collaboration in an online environment?

### 3.1 Participants and procedure

The target group was 88 students from a higher secondary school in Prague specialising in diplomatic services. The participants were the second year students at the age of 16 – 17 (twenty boys and sixty-eight girls). All classes were taught Social Science in CLIL. Two classes of 58 students (the experimental group) were supported by the use of a wiki environment, whereas in the third class of 30 students no online environment was applied (the control group). In each class the students were divided into six teams of four to five students for the whole course. We designed three collaborative and cooperative activities aimed at practising different collaborative skills. In the experimental group all three activities were assigned like out-class activities, while for the control group first two activities were assigned like school class activities and the third one in a form of an out class activity. Each activity was finished with the students' feedback and reflections.

*Activity – personal budget*

The task was to calculate a monthly family budget from monthly incomes and expenses and decide whether the family can afford to go on summer holidays. The control group worked at school for 45 minutes, while the experimental group worked at home in a wiki environment and the students had six days to accomplish the task. The cooperative and collaborative output of the activity was mainly to: follow directions, encourage others, clarify, negotiate, take turns, take responsibility, complete a task, suggest ideas, evaluate the process and products and track the progress towards the goals.

*Activity – a scenario at the bank*

The task of the second activity was firstly, to read a text on payment cards, especially on credit cards. Secondly, to write a scenario from a bank environment where advantages and disadvantages of holding credit cards were notified. Finally, to perform a scenario at school. The control group worked at school for 45 minutes, while the experimental group worked at home in a wiki environment and the students had six days to accomplish the task. The cooperative and collaborative output of the activity was mainly to: brainstorm, goal setting, and delegating, leading, team building and cooperatively work over time to achieve a common goal.

*Activity – a seminar paper and a five minute PPT presentation on a selected topic (e.g. investments, bank accounts, insurance, savings etc.)*

The third out class activity was for all groups the same, they had the same instructions, time to accomplish the task (3 weeks), and each team could choose their own form of communication. The cooperative and collaborative output of the activity was similar to previous ones, plus to practise resolving conflicts and managing time.

## 3.2 Data collection instrument

Qualitative and quantitative data were collected and examined from three sources: a questionnaire, focus-group discussions and analysis of students' project seminar papers. The questionnaire, which consists of 15 open questions, was designed to survey students' immediate preferences, attitudes and reflections to collaborative learning. In order to explore students' attitudes in-depth, a set of semi-structured interviews was conducted alongside the questionnaire. Interview questions were based on students' responses to the open questions in the questionnaire.

## 3.3 Results

The answers to the questions: 'What are the students' attitudes and experience to cooperation and collaboration in an online environment?' can be seen in Table 1, which summarizes the experimental group students' answers according to a cooperative or collaborative approach. Although the students were given exact instructions for collaboration (e.g. you should work as a team, you should make common decisions about the layout, the content and the summary of seminar papers etc.) without any doubts they turned into cooperation by dividing the workload into individual tasks and took responsibility only for their parts. Only two teams fully discussed the process of accomplishing their tasks at the beginning of the project and these two teams (altogether 10 students) also discussed the summary of their project, which served as a learning material for the whole class. The work division can be seen also in answers to questions four and seven, when the students felt the responsibility only for their tasks as an individualist and not for the team work as a unit. The question three shows the low number in asking for a help within each team. Based on focus-group interviews the students did not want to ask, because they did not want to bother somebody else and also they thought that they would not get the answer as the others worked on different tasks. Only 33 % of the students read the team materials more than three times.

**Table 1**: Overall experimental group students' answers to the questionnaire

| Question | **Cooperative approach**<br>Number of students | **Collaborative approach**<br>Number of students |
|---|---|---|
| **Who divided the work in your team?** | One or two persons<br>45 (78 %) | Each member discussed it<br>13 (22%) |
| **Did you agree with work dividing?** | Yes<br>58 (100 %) | Yes<br>58 (100 %) |
| **Did each member of a team work on a summary?** | No<br>41 (53 %) | Yes<br>27 (47 %) |
| **Your seminar papers had three different sources to look for the information, did you use all of them?** | No<br>2 sources: 6 (10 %)<br>1 source: 51 (84 %) | Yes<br>1 (6 %) |
| **How many times did you read the team materials?** | 1-3 times | More than 3 times |

| Question | Cooperative approach<br>Number of students | Collaborative approach<br>Number of students |
|---|---|---|
| | 39 (67 %) | 19 (33 %) |
| **Did you ask any of your team members for a help?** | No<br>47 (81 %) | Yes<br>11 (19 %) |
| **What were you responsible for while working on seminar papers?** | Some parts<br>58 (100 %) | Everything<br>0 (0 %) |

If we look at Table 2, which summarizes the control group students' answers to a cooperative and collaborative approach, we can see a few differences. They differ in questions one and three, in the experimental group the students preferred more a cooperative approach, while in the control group the students preferred a collaborative approach.

To assess team work we asked the students three additional open questions displayed in Table 3 and Table 4. There is no significant difference between the experimental and control groups. As we can see 88 % of the students from both experimental and control groups expressed the positive assessment to team work. Moreover, 80 % of the students marked the team members equally. Almost each student gave the same mark or higher to their team mates. The students who marked each team member differently, very often credited themselves higher than the others. To our surprise, 27 % of the students who thought positively about the cooperation expressed the wish to work on their own next time. Overall, 53 % of the students did not want to work in a team next time. In summary, 22 % of the students wished to work in pairs and 47 % of the students would like to work in teams and 32 % of the students wanted to work individually next time.

**Table 2:** Overall control group students' answers to the questionnaire

| Question | Cooperative approach<br>Number of students | Collaborative approach<br>Number of students |
|---|---|---|
| **Who divided the work in your team?** | One or two persons<br>9 (30 %) | Each member discussed it<br>21 (70 %) |
| **Did you agree with work dividing?** | Yes<br>30 (100 %) | Yes<br>30 (100 %) |
| **Did each member of a team work on a summary?** | No<br>9 (30 %) | Yes<br>21 (70 %) |
| **Your seminar papers had three different sources to look for the information, did you use all of them?** | No<br>2 sources: 7 (23 %)<br>1 source: 13 (43 %)<br>0 source: 2 (7 %) | Yes<br>8 (27 %) |
| **How many times did you read the team materials?** | 1-3 times<br>23 (77 %) | More than 3 times<br>7 (23 %) |
| **Did you ask any of your team members for a help?** | No<br>20 (67 %) | Yes<br>10 (33 %) |
| **What were you responsible for while working on seminar papers?** | Some parts<br>30 (100 %) | Everything<br>0 (0 %) |

**Table 3:** Assessment of team work – the experimental group

| Question | Answers | Number of students |
|---|---|---|
| **What was the cooperation like in your team?** | Positive | 49 (85 %) |
| | Negative | 9 (15 %) |
| **How would you mark the work of each member on seminar papers?** | Each member got the same mark<br>Each member got the different mark | 44 (76 %)<br>14 (24 %) |
| **Would you like to work on a similar project next time on your own, in pairs or in a team?** | On your own<br>In pairs<br>In a team | 18 (31 %)<br>14 (24 %)<br>26 (45 %) |

**Table 4:** Assessment of team work – the control group

| Question | Answers | Number of students |
|---|---|---|
| **What was the cooperation like in your team?** | Positive | 28 (93 %) |
| | Negative | 2 (7 %) |
| **How would you mark the work of each member on seminar papers?** | Each member got the same mark<br>Each member got the different mark | 26 (87 %)<br>4 (13 %) |
| **Would you like to work on a similar project next time on your own, in pairs or in a team?** | On your own<br>In pairs | 10 (33 %)<br>5 (17 %) |

| | | |
|---|---|---|
| | In a team | 15 (50 %) |

Based on focus-group interviews the students who thought positively about the cooperation, but they wished to work alone next time commented their attitudes similarly:

> *'I am not used to working in teams, it was new to me, it wasn't bad, but I prefer individual work.'*
>
> *'On my own, I can plan my work according to my free time, it is much better. I don't have to rely on anybody else.'*
>
> *'I think everything was ok, we agreed on everything, but I'd rather work individually, I can decide about anything on my own.'*

A few students commented team work negatively:

> *'Next time I want to work alone or in pairs. In a team there is always someone who doesn't work the why they should. It is more difficult to make agreements and put materials together.'*
>
> *'I would rather work alone, I like to keep my things under control, I like doing things in my way and how I need. I don't like to rely on the others, as I had bad experience.'*
>
> *'I didn't like the cooperation, our team wasn't well put together, and we didn't communicate often.'*
>
> *'Next time, definitely not in a group, there were a few occasions to work together, also dividing tasks is very complicated, we weren't good at compromising.'*

On the contrary the positive comments highlighted a good team spirit:

> *'I liked the cooperation very much, I liked how everybody wanted to take part in work.'*
>
> *'Next time I would like to work in groups again, because there are a lot of ideas and we can divide work.'*
>
> *'Awesome, to collaborate with girls is great.'*
>
> *'Definitely in teams, our work can excel and there is fun during collaborating.'*

The assessments of the teams' performances during the third activity (seminar papers and presenting the summary in front of the class with the help of PPT presentations) were almost the same, each team's seminar paper and presentation were assessed excellent or very good. On the other hand, team PPT presentations revealed the atmosphere and relationships among team members. The teams, where all students liked the cooperation and wanted to carry on in team work were very relaxed, they verbally supported each other and very often at the end of the presentations they hugged or patted each other's back. The atmosphere in teams, where some of the students did not like the cooperation, was always tense, less supportive and twice we experienced (when the students were back sitting at their desks) that they started arguing, it was in the experimental group.

## 4. Discussion

This study constituted a small scale experiment, and the learning context is critical to outcomes. The author does not make great claims about the generality of the results. Nevertheless, the findings from this study provide a good insight into cooperation and collaboration in a higher secondary level. Generally, the students preferred online cooperative learning to online collaborative learning. All the students declared to have outer motivation to get a good mark and inner motivation not to spoil teamwork. 88 % of the students expressed positive attitudes to cooperation. Based on focus-group discussions and reflections they worked individually on their share of work, they often communicated at school and through social media (Facebook, wiki and skype). They liked the idea of a group leader, who encouraged them, reminded them to accomplish the tasks and was responsible for the summary. The leaders very often felt uncomfortable while pushing the team members to work. It is supported by Graham and Misanchuk (2004, pp 184), who conclude that "Cooperative groups differ from collaborative groups in that they tend to have a "divide and conquer" mentality, where the cooperative group divides the work into chunks that can be done independently, and then assigns the pieces to the individual members, with greatest expertise to be able to complete the piece in questions. Thus collaboration in cooperative groups tends to occur primarily in the administrative aspects of the group such as deciding how to divide and assign the work among group members. "

The students did not like the situations, where they had to use collaborative skills (decision-making, checking someone else's work, compromising and arguing), because they wanted to solve it face-to-face and not through social media. We think that online collaboration collides with adolescent barriers. Adolescents like to express themselves visually and not in many words. Good writing skills are necessary for online communication, when students want to make arguments, justify their opinions or make decisions. It is not easy for them to express their feelings and attitudes in neutral words. As adolescents are "vulnerable to the negative judgements" (Harmer, 2009, pp 83), they do not want to enter into any conflicts because of being exposed to critics as well, and it is for most of the students unbearable. This is also the main reason, why the students do not want to work in teams in an online environment. The next reason for rejecting online collaboration is time availability. Firstly, the students had the difficulty in finding the time, when everybody was free to join the synchronous team discussions, and secondly, in case of asynchronous discussions they did not like the time interval between each contribution. Therefore they very often let the discussions for school breaks. Nevertheless, 70 % of the students from the control group preferred a collaborative approach during taking common decisions about planning activities and dividing tasks to 22 % of the students from the experimental group, also 70 % of the control group's students collaborated on a team summary. We assume, that the students from the control group, who worked on two cooperative and collaborative activities at school, could learn or practise the collaborative skills under a teacher supervision. The presence of a teacher helps to define a positive team learning environment where the rules of cooperation and collaboration are constantly observed, which is supported by Bennet "open communication had to be established and maintained for the team to succeed" (2004, pp 11). In conclusion, we suggest that at higher secondary level students should be encourage to cooperate both at school and in an online environment under conditions, that teaching and developing teamwork skills should precede any online cooperation. Collaborative skills should be first taught as a part of school cooperative learning and later be included in online cooperation. On the contrary to distance learners, in higher secondary level there is only a small added value to online collaborative skills, because students have the possibility to see each other every school day and thus they discuss everything face-to face. Overall, good communication skills and students' ability to manage crisis seem to be fundamentals for collaborative learning.

## 5. In conclusion

This study tries to show both benefits and drop backs of cooperation and collaboration among adolescent students. Although online cooperative learning seems to be more suitable and beneficial for this age group than online collaborative learning, collaboration in a class should be a part of learning. We think that both cooperative and collaborative learning at school and in an online environment might show students the strong and weak sides of team working. The school environment is rather protective, teachers try not to expose their students to negative or difficult learning situations. Unfortunately, the real working world is full of challenging moments. We believe that even higher secondary students should have, to some extent, discomfort experience when e.g. their team workers let the whole work on them, are not responsible and reliable, or when students have to take a role of a leader, motivate the others or face the arguments. At this school level, it is necessary, that a proper feedback and reflection must be done by teacher immediately after the activity to settle all arguments and negative feelings. However, it is clear that there is still much room for further research, especially in higher secondary vocational schools, where students start working after their graduation.

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# Dialogue in Streaming Video

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**Abstract:** Streaming video is often done with the lecturer talking and showing a digital presentation. Either you can see the lecturer in a part of the screen, or it is just the voice. This is the generic way of recording and streaming video for educational purposes. This paper evaluates a different way of presenting the curriculum; by peers discussing topics. Rather than one lecturer "telling" the listener about a topic, it has shown to be more dynamic to have a discussion amongst peers. The discussion is loosely held over a key word script and can be on a topic or, in this case, it is the solving of a previous exam. The setting has a resemblance to role playing, but is the form of a dialogue more than acting. The preliminary results are overwhelmingly positive. The research is also a part of a larger project called Project ActiveStudent at Hedmark University of Applied Sciences in Norway. The data is collected amongst the students from a survey using Questback, and group interviews.

**Keywords:** role play, streaming video, learning, peer discussions, dialogue

## 1. Introduction

Streamed video is used in different courses at Hedmark University of Applied Science, both in courses offered online and courses that require on campus attendance. Video streams have in a short time become very popular with the students. They claim it supports their learning process (Vold, 2014). Streaming video provide an opportunity for the students to stop and pause. Also the repetition has proved important for the learning process (Laurillard, 2002).

At Hedmark University of Applied Sciences most lecturers record videos for streaming in solitude. As teachers are assigned to courses, not in pairs, but one teacher per course, the teachers are also left to decide upon teaching material alone and often develop any additional material themselves. The teachers set up the camera and record what could have been an ordinary lecture, often using MS Powerpoint or another presentation tool. Then the video is made available for streaming via the Learning Management System (LMS) used by the University.

Where there are several lecturers connected to a course it is possible to explore other approaches to teaching.

This paper explores the use of streaming video where two peers discuss a case and use dialogue as opposed to one lecturer elaborating a case study. We will explore how the dialogue, as oppose to monologue, will support the learning process. The dialogue will resemble role playing, and although it is the lecturers that discuss, it will still be able to learn from the discussions.

The course is within the field of Norwegian Law studies – a 7,5 credit course that is offered in several study programs. The course is offered to "on campus" students. The LMS in use is called Fronter(Fronter, 2011). Within this field case studies as a method of teaching, has been used for decades as it has proved to be easier to explain and obtain understanding for the execution of laws by providing examples (LaPiana, 1994). These examples have then been called cases, hence the case study method. The stream showing the discussion was presented as a part of the teaching material in the course and was accessible in the LMS for two courses within law studies. They can be viewed several times.

The project "ActiveStudent" is an internally funded project within Hedmark University of Applied Sciences that test out and evaluate different ways of making students become more active with regards to their education. Through activating them, we want to achieve engagement and involvement in their own learning process (Merriam, Caffarella et al., 2007, Rogers, 2007) and contribute to their enhanced learning outcome.

The paper will firstly present theoretical reasoning for using dialogue in streaming video. Then we will discuss using cases in jurisprudence and the approach to methodology and data collection, before we conclude and present our plans for further research.

## 2. Theory on using digital cases

The reasoning for using digital cases, is that it will provide the students with real life cases for the students to learn from (Fossland, 2015). Using role play and cases in education is not a new phenomenon, but in later years with the emergence of the digital media, the role playing have sometimes been recorded and made available for replaying in a digital media. These role plays can be used as bases for discussions and thus more student active methods of teaching.

According to Fossland (2015) the discussions the take place after students watching videos are more effective. It provides a basis for reflections that support the learning outcomes from the courses that use this approach.

The videos provide a form of experiential learning, and although the students are not the participants in the video and as such are experiencing the actual case, they will be able to draw learning from the videos in a similar way as if they were to experience it themselves.

Particularly the reflection processes streaming video facilitates for what Donald A. Schön refers to as “reflection upon action” (Schön, 1987, Schön, 1991). This reflection supports the students in becoming reflective practitioners, and also contributes towards an enhanced learning process. The students will obtain a deeper understanding by reflecting together and discussing with peers.

Diana Laurillard and Ray Ison (1999) has presented “the conversational framework for the learning individual”. It is explained that a learning process is a complex process that requires at least two participants and they are to operate iteratively and interactively on two levels. The two levels are “practice” and “discussion” and the idea is to connect those levels by “the activities of adaption and reflection”(Laurillard and Ison, 1999). The students are interacting at the practical level via a “goal-action-feedback-modified action” cycle and the environment is constructed by the teacher – it may even be a streaming video session. They continue: “Reflecting on that experience at the discursive level, in dialogue with the teacher, they can articulate the theoretical representation of that particular action, in order to generalize and thereby enhance their further actions”(Laurillard and Ison, 1999).

The conversational framework describes the conservation between the student (learner) and lecturer (teacher). The figure (figure 1) depicts the teacher providing a theoretical representation to the students that reflect on a conceptual level ($Cs^1$) and through reflection/adaption or on specific interactions ($As^1$) develop a goal oriented behavior. This behavior will also be affected by the teacher’s mediation of the topic.

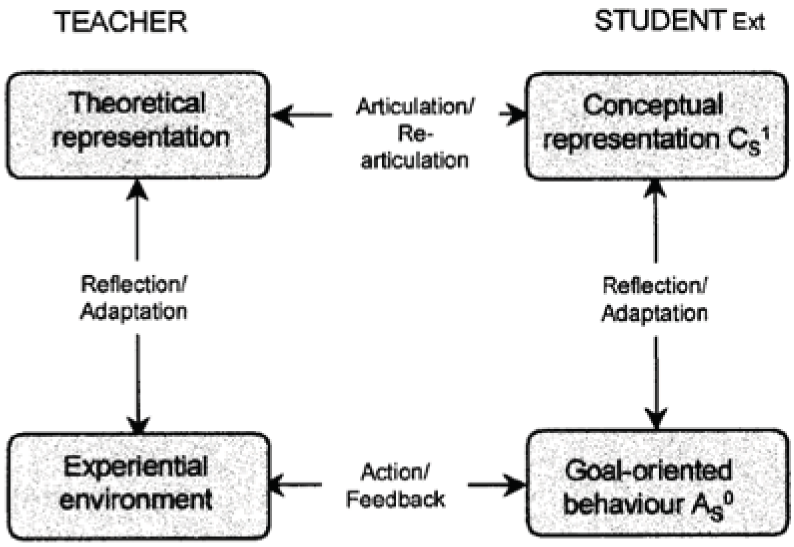


**Figure 1**: The conversational framework for the learning individual (Laurillard and Ison, 1999)

Figure 2 presents how the individual can learn from reflecting at the conceptual level (Cs¹ ) and on the teacher's presentation or on the interactions with the environment (As˚) and the interpretation of the experience (in a more generalized form) (Aɢ˚). The student may have acquired new knowledge if their generalized conceptual representation(Cɢ¹) has developed from a formulation of the specific learning (Cs¹ ) or from what is called the "generalized action knowledge" (Aɢ˚)(Laurillard and Ison, 1999). Figure 2 better describes the process of the student. The individual will have the roles of "the externally situated individual" and" the internally persistent individual" and the figure depicts the internal processes that this individual (the learner/student) is required to go through in order to learn.

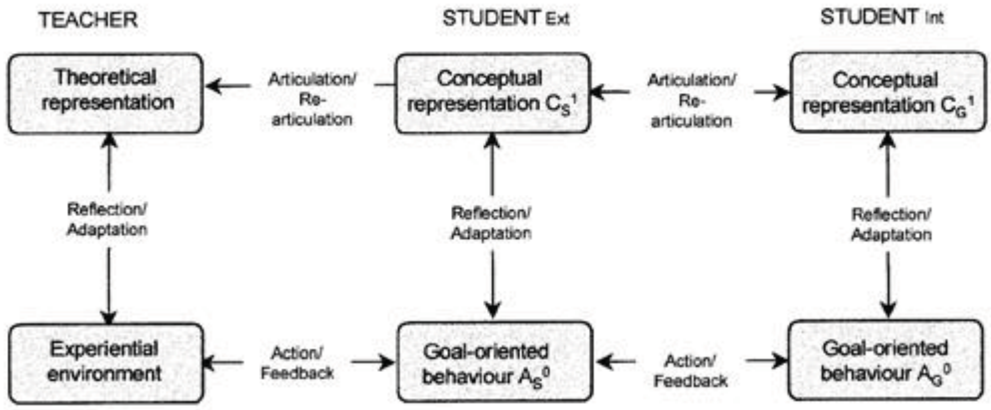


**Figure 2**: Internal structure for an individual to be capable of learning from experience (Laurillard and Ison, 1999)

Another figure that shows how learning can be facilitated is the Experiential Learning Cycle that was described by David A. Kolb. The experiential learning circle (Kolb, 1984) show the connection between experiencing, reflection and learning. Similar to having the concrete experience it is possible to understand the experience by watching the streaming video. The video in this case is a discussion between to peers (lecturers) regarding an assignment. To listen and watch the video may resemble the experiencing, and one may indeed have an experience when watching the video. Then it is desired that the student will be reflecting on their experience with watching the video. This can be done alone or together with fellow students. The reflecting is also facilitated during the lectures/seminars with the students. Here the students are encouraged to conceptualize and make use of what is learned from the streamed video and the reflection processes posterior to the streamed video. This can make up the basis for the students new experiences that may be "live", either as a part of a lecture, or even in their work life.

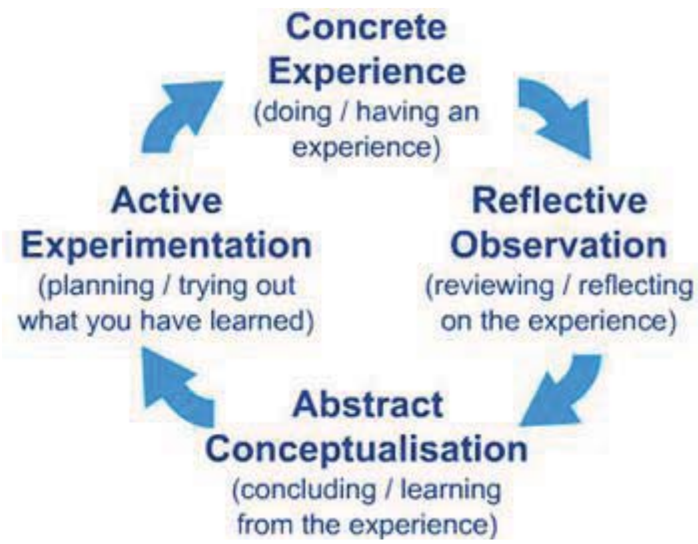


**Figure 3**: Kolb's experiential learning cycle (from: www.simplypsychology.com(McLeod, 2016))

Also the element of activity is relevant in vocational studies (such as law studies), as the relational competence is important in these professions (Bjørke, 1996).

Using streaming video can thus be used to approach material that is potentially difficult to obtain a substantial understanding by reading about it (Fossland, 2015). Tying the work of the students with practical examples displayed by streaming video may prove essential to the students learning process.

Using cases also increases the awareness about the different issues within this particular area of work life ( in this case within law studies) (Fossland, 2015).

The streaming video provides an opportunity for the students to train the ability of argumentation and discussion. This is in alignment with socio cultural learning theory where the students learn when they are actively engaging in discussions with peers and lectures and the discussions can be tied to relevant contexts (Bransford, Brown et al., 1999).

In this paper it is not the students that perform a role play, but the lecturers using dialogue to solve a case. However, the possibilities of learning through reflection from the video and also through discussions with peers and lecturers it will be possible to enhance the learning outcome.

## 3. Using cases in jurisprudence

Lecturing courses in Law in a classroom provide a possibility of discussing cases with students. Their exams will consist of solving a case. In courses in Law studies, the use of cases is necessary in order to explain the cases that are central to the legal method, ie the source of law doctrine. This is inter alia the study of how the law should be interpreted. Students will naturally acquire actual knowledge, but focusing is also on them to get a good understanding of legal issues. Solving cases is therefore extremely important, and it was therefore natural to make a video where we have a conversation about legal issues related to a case. The case was named “Mothers home bakery”. The case is in the area public administrative law. The objective is to that the students learn how to apply the Public Administrative Procedures Act (in Norwegian: “Forvaltningsloven”).

The actual legal statutes in question will very often not provide an exact answer. This means that the text of the statute must be interpreted. To do so, a number legal sources, will be taken into account (Eckhoff and Helgesen, 2001). One of these relevant factors is court decisions, meaning decisions in previous cases. This is partly why the focus is on the case and case law. Jurisprudence is therefore largely an applied science. It is applied when the courts make their decisions. If there is a previous Supreme Court ruling that contains a question, and a case with similar issue submitted to the courts later, the general rule is that the Supreme Court is based on the previous case study they have solved. Straight Science also used when legal theory discusses how the case should be resolved(Fleischer, 1998) (p. 177).

Before the student acquires legal understanding, the student must work with cases. Case based teaching is for this reason apparent in all law courses. Different methods are used. Firstly there is always a collection of cases in the LMS available for the students to solve when he or she wants. There will furthermore be posted proposed solutions to cases. Assignments or papers awarded with an A are sometimes also made available for the students as example papers, providing the submitting student gives permission to posting it in the LMS. We would also make available guidelines pointing out which sections to take in to account usually in form of an examiners guide. In order to sign up for an exam it is usually mandatory to submit a case based paper in the LMS. In most cases the students then get a chance to solve a case used in a previous exam.

To enable students to benefit from the streaming video, it is important that the topics included in the case are within areas where they have at least some basic knowledge in the concrete area of law. It is also important that the first case they work with is not too complicated. It is also important that the review answers the key questions in the case. After the case study is laid out, it may be helpful to discuss with students what they possibly benefited from.

There are also “ordinary” videos where concrete case are discussed and solved using monologue. In addition to talking about the relevant statutes we do also talk about practical issues relevant to students, such as how actually quote a relevant statute.

Also the general issues on how to write a good examination paper is discussed via streaming video.

## 4. Methodology and data collection - evaluating "the discussion stream"

In order to evaluate the students learning outcome of watching the stream, a survey was developed using the survey program called Questback. The link to the survey was made available in the LMS. Of a total of 200 students participating in the courses, 109 students have watched the discussion stream at least once, according to the statistics available in the LMS. The questionnaire was answered by 35 students, giving an answer rate of 32%. These students were self-recruiting, not randomly selected.

The survey consisted of both quantitative and qualitative questions. The questions were to provide us with an understanding of how the dialogue in streaming video was perceived and if it contributed towards the students enhanced learning outcome. The low number of respondents indicates that there is a need for a more extensive investigation.

However, the answers we did get will provide us with some insights. As the numbers above shows, about half of the students in the group have been watching the stream presented in the LMS. One third of these have answered the survey. One may assume that these respondents might be the more serious, hardworking students. These students will probably be a selection that are more interested and or dedicated than the average student, and thus more positive towards the use of what can be seen as an extra learning activity.

Some of the students own comments show that they are not that homogeneous as a group. Some comments indicate that the respondents, all though signed up as "on campus"-students, still choose to take the course online rather than follow live lectures. Some of the feedback indicates that the streaming videos provide the students with a better understanding of the curriculum. One respondent even state that the streaming videos showed what the law-courses was "all about". Even if the number of respondents is limited, the general feedback is that a) the streaming videos are helpful in learning about the curriculum, and b) the dialogue in the streaming video provides an enhancement by being less static than a lecture.

The students report back on question about which factors regarding the streamed videos contributed to enhance the learning outcome of the course (translated from report): "…that there was a dialogue", "… the way they discussed", and "…that they discussed about an assignment".

The students also respond that they disagree on this being useful for only this class and course and that this would be useful for other courses as well. What we can interpret from this statement, is that this could be tested out in more courses. The students appreciate this way of adapting to the themes and would consider trying this for other courses.

Also reports as (translated from report): "… it is very useful to watch this again before exam", "…I could pause the video when needed", and "…it was a good supplement to the books" show the use students have had regarding the streamed videos.

Some students report on the videos being too long. Even if they can pause them, the topic is too wide.

Although a higher percentage of students responding might have given a broader view of the whole population, the survey provide important feedback from the students on the use of discussion in streaming video as a teaching method, and also as a support of the experienced learning outcome of the students.

Om addition to the survey some group interviews were undertaken. The group interviews (Dalen, 2011) were conducted as conversations. The respondents were positive and mostly confirm the feedback from the survey. They are positive and claim that both the ordinary videos and the videos with the dialogue have contributed to the learning outcome. They claim that the videos with the dialogue made the cases more interesting. The discussion between the peers made the topic easier to understand and thus contributed to an enhanced learning outcome.

The mixed method approach to collecting data has provided us with valuable insight. And although the low number of respondents to the survey, it definitely support a further investigation into using dialogue in streaming video.

In order to validate and secure the data, we conducted member checking (Guba and Lincoln, 1989).

## 5. Conclusion and further research

Using dialogue in streaming video has proved useful, according to the respondents. Even if we did not get the desired response rate, the response received still show that there is a need for streaming videos and also that the dialogue in streaming video where peers are discussing cases is contributing towards an enhanced learning outcome.

It supports the learning process by providing important insight in solving a case. The discussions give grounds for reflective processes (Schön, 1987, Schön, 1991), and the respondents claim that it provide valuable insight on solving cases as well as it makes the case more lively and thus easier to follow and learn from.

The data indicate that this needs to be investigated further. Particularly to split the videos into smaller videos might be useful to test out. Maybe not a whole assignment should be on one stream, but divided into sections and subsections would have been beneficial.

The low number of respondents shows that we need to explore this further in order to obtain more substantial data. However, the positive response has intrigued fellow lecturers to test this further.

Dialogue in streaming video will thus be investigated further, and it will also be implemented in other courses and study programs at Hedmark University of Applied Sciences. One of the courses that will have dialogue or peer discussion regarding solving a case, is “Learning Organizations” that is a 7.5 credit course in the half year study program called “Knowledge Management”. This course also uses case studies extensively in the lecturing. The students will have the opportunity to stream at least two videos using dialogue.

We will use surveys, group interviews and also personal interviews (Creswell and Clark, 2007, Dalen, 2011, Patton, 2002) in order to establish the effect and if the students perceive an enhanced learning outcome.

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# E-Learning Ecosystem Awareness and Professional Identity in e-Learning Technology Adoption

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**Abstract:** Universities adopt e-learning technologies hoping to improve learning and teaching and enhance competitiveness. However, the extent of take-up differs among academic teaching staff and often falls short of institutional aspirations. This research explores the adoption process in the context of a New Zealand university where a learning management system (LMS) is implemented. We draw on two fundamental notions: the learning ecosystem and professional identity to analyse qualitative data. Two exploratory studies are described, both conducted as parts of a longitudinal insider action research project. The first draws on focus group data from faculty based staff, both teaching and technology support, who are required to adopt the new e-learning technology. The second comprises communications from the central unit charged with facilitating the implementation of the new LMS institution-wide. By comparing data from faculty teaching teams and the central learning technology team, we provide insights into conceptions of the e-learning ecosystem, professional identity, and expertise that shape communications. We provide a series of practical and evidence-based recommendations for enhancing the adoption process.

**Keywords**: e-learning, learning ecosystem, technology adoption, professional identity, higher education

## 1. Introduction

Technology adoption in an institution occurs at two levels. An institution decides to adopt a technology and then individual staff within the organisations form their own views regarding their adoption of the innovation (Frambach and Schillewaert, 2002). In higher education, e-learning technological innovations are implemented by universities (Browne et al., 2006) with the aim of transforming education practice (Coates et al., 2005). However, the underuse of educational technologies is not uncommon (Quinn, 2012), implying that learning technology adoption at individual teaching staff level often falls short of universities' aspirations.

In this paper, we draw on the notion of e-learning ecosystem and professional identity to identify conceptions of the e-learning ecosystem and explore the origins of differential adoption among teachers. We assess the extent to which communications from the central university team address teachers' concerns stemmed from their professional identity and so serve to facilitate the adoption process.

## 2. Literature review

### 2.1 E-learning ecosystems and their characteristics

The notion of a 'learning ecosystem' is being used increasingly to capture the complexity and interdependent nature of learning and teaching agents and infrastructures. Within this conception, learning is perceived as being integrated into dynamic, collaborative relationships between multiple stakeholders and consequently a high level of technological interconnectivity is demanded. For learning to be authentic and relevant not only must an ecosystem support engagement with teachers and other learners it must also enable collaborations with objects and people in the external environment. Gütl and Chang (2008) identify the five most important elements in a learning ecosystem to be the learning content, the learning process, the learning community, organisational factors, and technologies. Reyna (2011)'s digital teaching and learning ecosystem captures most of these dimensions and probably conveys the extent of most ecosystems as envisaged and operated using university LMSs (figure 1).

Other authors offer models of learning ecosystems that identify multiple additional and distinct roles, including authors, assemblers, cataloguers, publishers (Collier, Piccariello and Robson, 2004) and instructional designers, multimedia producers, subject matter experts (Ismail, 2001).

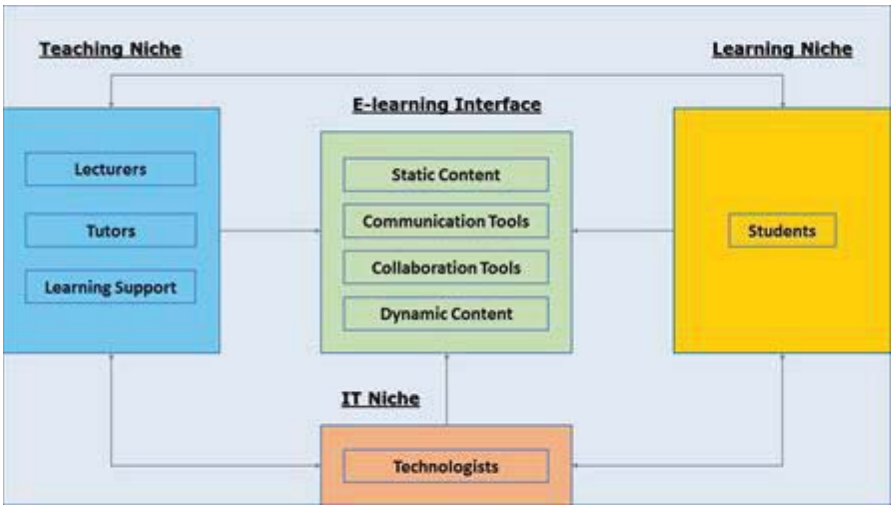


**Figure 1**: Digital teaching and learning ecosystem adapted from Reyna (2011).

Teachers' role within a learning ecosystem is blurred with roles of both learners and other agents, it is necessarily collaborative and depends on interaction with, in ecosystem terms, biotic units (living organisms) and abiotic units (non-living components such as media and tools). Within an ecosystem perspective, no player is superior, all are critical. The conception of a lecturer as but one element in a complex system contrasts markedly with that of the traditional university teacher; recognised as an expert, qualified to teach by virtue of their own learning, responsible for their whole design to delivery and assessment process, and expected to operate quasi-independently. It would seem likely that teachers who are perceived by some as agents within a complex e-learning ecosystem but have conceptions of professional identity formed in lecture-based teaching will experience some dissonance.

## 2.2 Teacher's changing professional identity

Professional identity is one's professional self-concept based on attributes, beliefs, values, motives, and experiences (Slay and Smith, 2011). Such a way of thinking acknowledges the place of individual within work roles, employee agency and the subjective nature of work place behaviours. Individual agency and social structures can be seen as co-constituted and co-dependent (Thompson, 2012). In an increasingly technologically dependent learning and teaching environment, academics' professional identities are likely to be shaped by both their interpretations of their positioning as teachers (Van Veen and Sleegers, 2006) and their relationship with technologies (Alverez, 2008).

Simpson, Finnegan and Stevens (2013) coin the term 'technoidentology' to capture the relationship between individuals and the technologies they use in the course of their work. Stein et al. (2015) note how identify related affective reactions can be categorised and predicting use behaviours and Stein, Galliers and Markus (2013) provide of technologies becoming part of identity related expressions of self and position.

Van Veen and Sleegers (2006) note, educational innovations are often introduced without fully involving the teachers who will use them. They suggest that staff reaction depends on whether they perceive the innovation as aligned with or running counter to their conceptions of their identity as teachers. Ketelaar et al. (2012) claim that teachers actively position themselves in respect to innovations and in doing so are considering and modifying their conceptions of their professional identity. They identify three concepts that are instrumental to this positioning process: ownership, sense-making, and agency. Feelings of ownership bring with it a sense of involvement and purpose, and this is likely to lead to early adoption (Bergen and Veen, 2004). Agency is the extent to which and individual feel in control of their work and free to make decisions. Agency is shaped by personal goals and situation and declines if goals are stymied or opportunities to exercise choice and influence are absent. Sense-making is an ongoing conceptual and emotional process by which a personal interpretation of innovation is formed and professional identity confirmed or adjusted.

Put simply, introducing new learning ecosystem infrastructures is likely to threaten teachers' professional identity and efforts to facilitate adoption are likely to be successful to the extent they afford agents ownership, enable successful sense-making and can be accommodated within existing frames of reference.

The research explores issues of e-learning ecosystem awareness and professional identity with the long-term aim of improving the support offered to staff and so aiding the full implementation of technology-based innovations. We focus on the conception of and interactions within the e-learning ecosystem among faculty based staff and the university central learning technology team.

We ask three research questions:

- What conceptions of the e-learning ecosystem do centrally located technical staff and faculty based teaching staff portray?
- How do the central team communicate and engage with teachers in an effort to facilitate the adoption process?
- What aspects of professional identity shape teachers' adoption process and the support they accept?

## 3. Method

The research took place at the Business School of a New Zealand university, where a new LMS was implemented university-wide. We took an insider action research approach (Jrad, Ahmed and Sundaram, 2014). Action research refers to the collaborative, reflexive, and interventionist process aimed at enquiring practical knowledge (MacIntosh, Bonnet and Coghlan, 2007). The word, "insider", refers to the situation where the action researcher is also a member of the organisation (Coghlan and Brannick, 2014). Insider action research is particularly useful for developing knowledge regarding how key actors perceive and enact their roles in organisational change (Coghlan, 2003), which in our case is the university-wide implementation of an e-learning technology.

We analysed two sources of data: newsletters and focus groups. In the first study, 50 weekly newsletters were sent to teaching and support staff by the central team. They were analysed using conventional content analysis techniques (Hsieh and Shannon, 2005) in conjunction with Leximancer. In the second study, data was collected from focus groups for faculty based teaching and support staff. Each focus group was facilitated by the authors. Discussions were recorded and transcribed.

## 4. Results

The content and interpretive analyses relating to each research question are described in turn.

### 4.1 What conceptions of the e-learning ecosystem do centrally located technical staff and faculty based teaching staff portray?

Analysis of newsletters issued by the central technology team displayed an overriding emphasis on the abiotic component of the learning ecosystem. Migrating courses, providing information and resources, and communicating project progress were its priorities. The top three vocabularies (Figure 2) were "course" (495 counts), "information" (257 counts) and "staff" (187 counts). Almost half the newsletters contained feature-specific guidance.

In contrast, only five entries across the 50 newsletters related to the biotic components of a learning ecosystem. They were the management of non-taught courses (document 30), cross-listed courses (document 30), and the LMS roles and access level (document 34, 38 and 43). Even then the entries provided step-by-step guidance without explicitly communicating the rationale for a change in teaching practice.

Experiences written by early adopting teaching staff were included in newsletters on eight occasions with an emphasis on the ease with which the new LMS could be adopted. The central technology team did not comment on these accounts of the LMS in practice. There was no communication of student learning experiences in the newsletters.

Transcripts of focus group work with faculty based staff revealed a different emphasis and awareness. Faculty based staff referred repeatedly to the biotic components of the learning ecosystem. Discussions centred on the consequence of the LMS for teaching staff and students. "People" (55 counts), "students" (38 counts), and "marks" (28 counts) were the most frequently mentioned vocabularies (Figure 3).

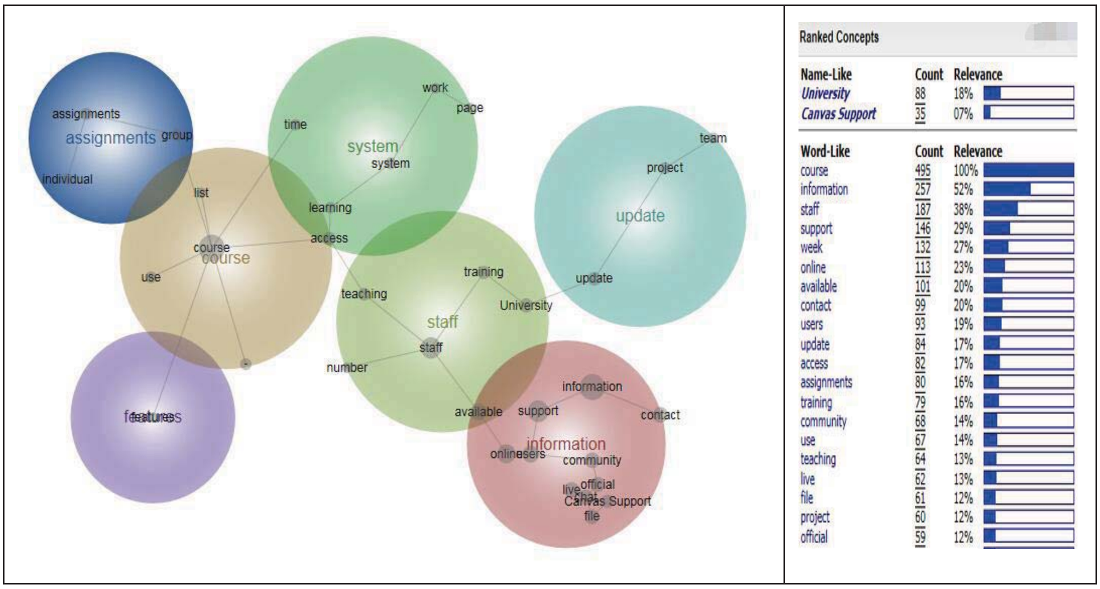


**Figure 2**: Concept map and frequency for central technology team

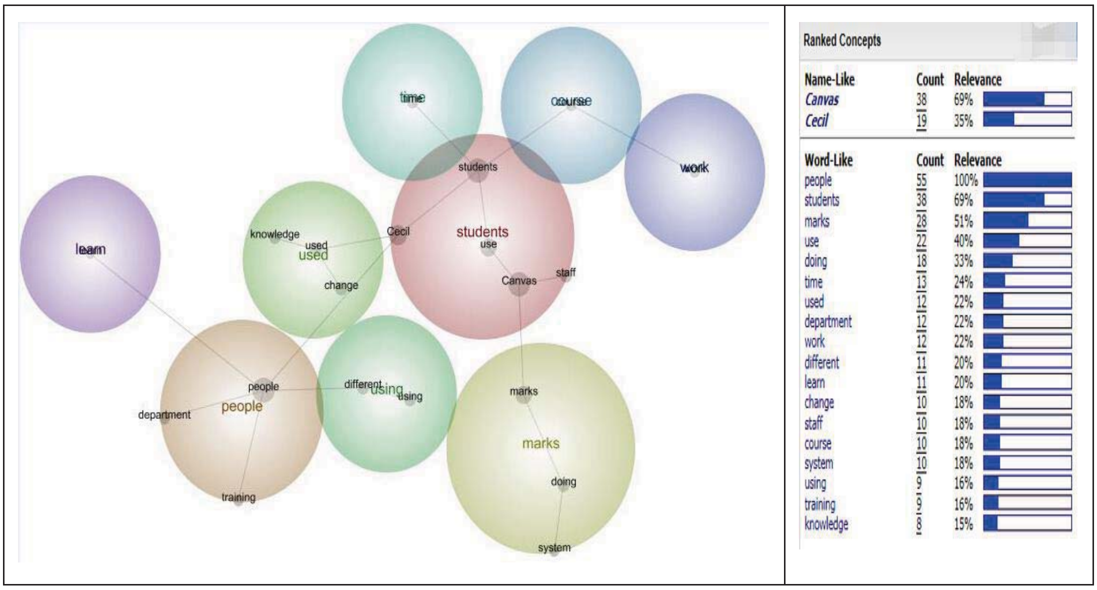


**Figure 3**: Concept map and frequency for the focus group with teaching staff

Looking beyond frequency counts to direct quotations, teaching staff made little mention of agents outside their immediate faculty including the central support team or their newsletters. One or two individuals mentioned the need for better communication and 'the university' was mentioned as an ill-defined other and a source of policy and decision making.

> *"It would help if there was some kind of feedback on what kind of things people are using in the LMS. You know…so many percents are doing this and here are what your colleagues are doing. That might get some people who are just not doing anything to allow them to evaluate 'Oh a third of everybody is actually using this, and I've never used it' (lecturer)."*

> *"Policies and instructions are being formulated… a lot of these decisions are flowing through after we have already been impacted"; "That's one of the problems… the communication to the people at the coalface… if they know it now, they should be telling us now (lecturer)."*

## 4.2 How do the central team communicate and engage with teachers in an effort to facilitate the adoption process?

Newsletters throughout the period revealed three identities related positioning that dominated the communication from the central team. They were: project manager, technical expert, and reporter. First, the central team updated staff on project-related plans, milestones, and progress. Seven newsletters mentioned critical events such as vendor selection, early adoption plan (early exposure training (document 17), faculty champions and support staff, and deadlines for making courses available to students. Second, consistent with the emphasis on abiotic components of e-learning ecosystem, the LMS feature guidance (19 newsletters) and new feature development (9 newsletters), technical expertise is reflected in the vocabulary and tone used. For example:

> *"It's important that staff who have attended training in Canvas and have been using a sandpit course to learn and play, move any content into the course shell of the relevant 2016 course when it is ready (document 31)."*

> *"If no additional assignment groups are created and weightings specified for them; then the individual assignment points allocated would be treated as the weighting or the relative weighting towards the final total mark (document 44)."*

That the central team has expertise, feel they know what staff should do and how the system works is clear from the tone. The extracts are probably comprehensible to their authors and to staff who are early adopters but could be quite obscure to others. Having said this, there was a clear effort to couch advice in acceptable language and avoid too much techno-speak. There is little reference to the relationship between the new LMS and the previous one which was familiar to most lecturers.

Finally, communications from the central team are essentially one-way. Of all the 50 newsletters, only 2 of them responded to staff's queries on training and specific LMS features (document 14 and 15) and few attempts were made to address teachers' feedback (see table 1). Teacher's personal landscape and students' experience were almost absent from newsletter communications.

**Table 1**: Numbers of entries and newsletters by communication content

| Communication Content | Numbers of Entries | Numbers of Newsletters |
|---|---|---|
| Project milestones | 7 | 7 |
| Project progress | 25 | 23 |
| Training reminder & progress | 16 | 15 |
| Technical features | 29 | 19 |
| New features development | 9 | 9 |
| Sharing from teaching staff | 8 | 8 |
| Response to queries | 2 | 2 |

## 4.3 What aspects of professional identity shape teachers' adoption process and the support they accept?

Focus group transcripts were screened for utterances that related to adoption of the new LMS. A number of themes were evident in the conversations of teaching staff and those who supported them. Each theme conveys a distinct aspect of professional identity. Teachers who expressed lesser or greater alignment with these themes also differed on the degree to which they aligned with the innovation.

The themes were: the centrality of teaching role to professional identity, adoption of a broad and diffuse conception of teaching and teacher as learner. Each is considered in turn below:

### *4.3.1 Centrality of teaching role*

Data from focus groups echoed Skelton (2012)'s three categories of professional identity that university teachers possess: researchers who teach, teachers who conduct research, or blended professionals. Teaching and support staff remarked that teachers who viewed teaching as a priority compared with other competing tasks tended to adopt the LMS more willingly and see it as a means of enhancing their effectiveness. Staff who prioritised research found the innovation intrusive and to impact on workload.

For example compare:

> *"It's teaching. (It is) not that important (lecturer)" and "It's just basically creating more work (lecturer)."*

With the insight of a support staff member:

*"What I have found is that those who are very keen and who have teaching in their higher priority over their other commitments will be the ones who keep pushing the boundary regardless of the system that we use anyway (support staff member)."*

#### *4.3.2 Adoption of a broad and diffuse conception of teaching*

Staff who saw their role as including administration, course design and two-way communication with students tended to view the LMS positively. Teaching staff who managed large courses seemed more likely to appreciate the efficiency of the new LMS.

*"The record keeping is just tremendous for me now, everything I have to do, emails, everything I need to put on an Excel spreadsheet (lecturer)."*

*"(The LMS) has actually saved me a lot of time in delivering the course side of things, the materials, and the administration and marking (Lecturer)."*

Other staff whose identity was that of a traditional lecturer (Prosser and Trigwell, 2014) had difficulties in seeing advantages in the new LMS and found it uncomfortable to communicate with students outside scheduled teaching sessions.

*"'my role as a lecturer is that I show up in front of classes', anything else is probably not something they consider too much (lecturer)."*

*"Communicating with students online, it's not natural. 'I'm just used to I'm the lecturer I stand and deliver', yet there is a function on the LMS where the student can reply (lecturer)"*

#### *4.3.3 Teacher as learner*

Some staff appeared reluctant to adopt the LMS because their expertise might be challenged. Staff whose identity as a teacher included being a recognised expert necessarily found the risk of making mistakes, surrendering control to learning support staff or acknowledging their lack of capability difficult. Other staff were very comfortable with learning to use the new LMS and exposing the students to evidence of their fallibility.

*"I've been changing things around quite a lot, and I actually don't care if the students think I'm stupid or not. But some people are saying that 'if I change things (in the LMS) I will look like I don't know what I'm doing' (lecturer)."*

Faculty support staff reported that teaching staff preferred private, one to one sessions where they could minimise any embarrassment caused by lack of expertise.

*"They would like somebody to sit there so that they feel 'I'm not going to muck it up. I'm going to do this right, because somebody is sitting with me' (Support staff member)";*

*"They are not afraid that everyone is around them or that they are asking stupid little questions…they are more open to their questions and they are more willing to learn as we sit there next to them (support staff member)."*

#### *4.3.4 Sense-making and agency*

The overriding preoccupation of the teaching staff was in understanding the innovation in terms of their existing frameworks and identity. Faculty based support staff and teaching staff themselves referred repeatedly to the attempt to replicate previous teaching models.

*"I think in the beginning they want to achieve the same thing as they did in the old LMS (support staff member)."*

*"It hasn't changed at least the way we teach our courses. We are just doing the same thing as (we were) in the old LMS. We are trying to mimic the old LMS in the new LMS. We are not changing anything (lecturer)."*

Similarly, faculty based staff detailed efforts in their own teaching and in supporting others to reframe the new technology by using established vocabularies. They emphasised the importance of being able to take teaching staff on a journey and stressed that making the relevance of the new LMS features to teacher's previous teaching facilitated the sense-making process.

> *"If you tell them this is how we do structure, it doesn't click. If you tell them this is how you used to do it, this is now the new name of that. The structure is already in their head (support staff member)."*

> *"There is one exercise we could do and it has already been done and it has been useful for me…translation (lecturer)."*

The feeling of agency and ownership was achieved locally by enabling teaching staff to take the lead in asking questions, and seeking specific advice from support staff and giving hands-on support in one to one sessions.

> *"Some courses focus on the structure of assignments and so they like to know how to set up assignment groups and how to set up the ratings in the assignment group. Some lecturers are focused on quizzes, so they want to know how to set up a quick question bank, and how to randomly select questions and form the quizzes. So in that way the concept can be very different but that's the key point, they want (support staff member)."*

> *"We are going to need quite a bit of support around grading time" and "We don't know anything about it in terms of entering marks on the system and doing scaling (lecturer)."*

> *"I think most of the learning is done in the one-to-ones. I think that the bigger (training) sessions they don't actually learn much but it's still useful as a primer, it's like doing a pre-reading before going to a lecture (support staff member)".*

## 5. Discussion

This research set out to explore an institution-wide e-learning adoption through two lenses: the learning ecosystem and professional identities. We posed research questions relating to conceptions of the learning ecosystem and professional identity and asked how each shapes communication and orientations towards the introduction of a university-wide learning platform. Both lenses provided useful insights that could guide future adoption support. Our findings are clear: faculty based teaching staff and the central technology team staff expressed their understanding of the learning ecosystem in markedly different ways. Approaches to the ecosystem and the adoption of a new infrastructure appeared to be shaped by professional identities relating on the part of the central IT staff to project management, technical expertise, and reporting. Within faculties teaching identity varied in terms of the centrality of teaching, conceptions relating to the breadth of the teaching role and the degree to which teachers saw themselves as having to display expertise. There was firm evidence of teaching staff striving to make sense of the new learning system by interpreting the innovation within existing frameworks.

The first and second of our research questions relate to conceptions of the ecosystem and communications by the central team. We found that teaching staff appear to see themselves as central. The teaching community is understood by faculty members as limited to their department or faculty. They infrequently in discussions regarding abiotic elements such as collaborative tools and dynamic content. The central team, on the other hand, focused on the abiotic and is largely silent or fails to problematize the changes in practice required of teaching staff. Given these differences in awareness, frustrations are likely to arise as the communications issued by technologists are not on the ecosystem map of many teachers let alone being their high priority concerns.

The third research question related to teachers' identity. In our analysis of focus groups, we noted frequent incidents and utterances that related to issues of teacher professional identity. Implicit role perceptions appear to provide a sharp focus for individuals in terms of how they regard the new LMS, what features they are interested in and even how willing they are to attend training. None of the teachers seemed to see learning as occurring within a complex collaborative ecosystem. All of them voiced to a greater or lesser degree a teacher-centric understanding and varied in the degree to which they nurtured learning through communication and content. Those who regarded teaching as central to their role tended to be willing to learn about the LMS. Those who viewed teaching as extending well beyond the lecture theatre were more likely to appreciate the value of the LMS.

Support for sense-making and feelings of agency and ownership emerged within the faculty through close and infrmal collaboratve working and, through explicit efforts to make the LMS relevant to previous teaching practice, and sensitivity to the emotions associated with the introduction of the new LMS and its concomitant threat to identity. Sannino (2010) similarly notes that opportunities to collaborate and engage in free discussions with peers help in the sense-making process and that understanding the new in terms of the old is the first step in moving to full adoption and adaption.

## 6. Limitations

This study draws on a limited number of focus groups and documents issued within one institution and relates to one LMS. While the claims we make regarding the insights that can be obtained by adopting ecosystem and identity lenses are probably sound, our specific findings are likely to vary between institutions, implementation strategies, and ecosystems.

## 7. Implications

We interpret our results as indicating that: professional identity shapes perceptions of the relevance of the introduced technological innovation and motivation to learn about them; and so determines adoption behaviours. Teacher's adoption of e-learning is not determined solely or even largely by the objective characteristics of the learning technology. Therefore, training and specifically on how to use a technology will have a limited effect on performance. It will not change the way teachers see the learning technology nor will it speak to their practice. The authors suggest that adopting a professional identity perspective to innovation implementation would render interventions and training more effective and efficient.

As an intreim step, providing agents in the ecosystem with an insight into the existence, roles and challenges of other agents is likely to enhance tolerance and communication. In our analyses, much appears to be assumed that was partial and this shaped the way people approached the innovation. Our analyses lead us to suggest that central teams, like effective teachers, need to know whom they are helping. They need to engage with faculty in the exchange of information and exploration of priorities in way that are not rigidly predetermined. Such a shift is unlikely to be easy. Asking technologists to help teachers to conceptualise the new in terms of the old is likely to appear counter intuitive. It could well be regarded as a retrograde step when they are all too aware of the many features a new system has to offer.

In our study, teachers were appreciative of one to one support which provided space for exploring the implications of the innovation, for sense making and agency. How such support could be provided when resources are limited and time is short is the subject of our ongoing research.

## 8. Conclusion

Our research demonstrated how awareness of e-learning ecosystem differentiated across its inhabitants, and how this scatted awareness left the e-learning ecosystem fragmented with each group of agents operating in semi-isolation. We further highlighted how teachers' conceptions of profession identity shaped their individual attitudes towards an innovation, hampered communications between cross-functional teams and impeded the adoption process. Finally, we presented, based on practical experience, strategies to facilitate sense-making, and create feelings of ownership and agency, which in turn enhance teachers' adoption of e-learning technology.

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# Mobile Learning Spaces for a Mobile Generation: Redesigning the Classroom

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**Abstract:** Higher education learning spaces are coming under increasing scrutiny. Some leading commentators say that the way in which universities were originally designed no longer caters to the needs of 21st century education. According to Keppell and Koskinen (2013) "The design of spaces to support the generation of knowledge by students themselves is an important yet neglected field. We need to re-conceptualize, re-design and rethink the use of space." A number of universities have implemented major structural projects to create learning spaces that facilitate collaborative learning experiences that are typically not possible in large lecture theatres. Examples of such initiatives involve the use of round tables or lab benches, flexible/movable seating, extensive new wireless technology, and room configurations that increase opportunities for peer interaction. All of this, however, comes at a significant financial cost depending on the extent to which changes are made. There are, fortunately, opportunities for relatively small-scale refurbishments that may help to create learning spaces and learning experiences more suited to today's mobile generation. This paper describes how, informed by learning space design principles and staff survey data, one Irish university upgraded a selection of standard flat classroom layouts into areas that facilitate active, collaborative, and mobile-enabled learning approaches. It discusses why certain physical and technical elements were prioritised and how specific design principles from the learning space literature were interpreted and realised. This case study describes how staff responded positively to the redesigned space. It aims to contribute to the under-researched literature on how learning spaces might potentially impact students' learning outcomes. It also includes lessons learned from the design experience and outlines plans for upcoming initiatives that may be of interest to other institutions.

**Keywords:** learning spaces, 21st century, next generation, net generation, active learning, mobile, classroom, design

## 1. Introduction

The design of learning spaces in higher education is becoming big news. Universities in most countries are struggling to optimise their use of space, driven by rising student numbers and limited/static budgets (Ellis & Goodyear, 2016). Allegedly in response to rising student expectations, UK universities are pumping more money - £9 billion between 2012 and 2017 - into their capital expenditure programmes to maintain competitiveness (Jones, Sutcliffe, Bragg & Harris, 2016). In Ireland too, the pressure to build is on, with significant capital expenditure, over €220 million, announced by Dublin City University (DCU) in recent months (DCU Campus Development Plan, 2016-2020). Some of these design projects involve the erection of extensive new built environments while others involve the upgrading of existing campus facilities to better accommodate the needs of so-called 'net generation' students.

Despite such significant expenditure, however, the question of how much all this investment is impacting or will impact learning remains unanswered. According to Fraser (2014), up until relatively recently, the vast majority of literature focused on the design and evaluation of new learning spaces while very little research discussed the impact of such spaces on pedagogic practice and student learning outcomes. Similarly, Blackmore, Bateman, O'Mara and Loughlin (2011) write that "Much of the literature focuses on the quality of conditions and not educational practices or how space is used, and with what effect" (p. 5). Furthermore, they agree with previous researchers who found that there are many "sweeping" statements about the potential effects of learning spaces on student learning that are not substantiated empirically (p.5).

This paper seeks to explore if relatively small-scale changes can potentially impact on teaching and learning in a redesigned classroom. It describes the design process that was followed to upgrade a set of classrooms at an Irish university (DCU) and it includes initial responses to the redesigned space. It compares the process followed with current literature and concludes with suggestions for other institutions based on lessons learned.

## 2. Literature review

Most universities claim to adhere to the theory of constructivism, a learning theory based on the belief that individuals 'construct' their own knowledge through interactions and experiences with their environment. Central to the constructivist viewpoint is the idea that the learner is an active processor of information. This is in sharp contrast to the theory of behaviourism, for example, in which the learner is viewed as a passive receptacle for information. (Rovai, 2004).

Universities are also placing a growing emphasis on fostering what are called 21st Century skills relating to critical thinking, collaboration, agility, communication, digital literacy, and creativity in graduates (Wagner, 2014). The ability to discuss, collaborate, and work as a team are seen as particularly important attributes for graduates today to prepare them for a fast-changing workplace environment. Writing about the pedagogy of discussion, Brookfield and Preskill (1999) say that discussion helps students explore a diversity of perspectives, recognize and investigate assumptions, and encourages attentive, respectful listening.

However there is a sharp contrast between these types of ideals and the realities of the physical learning environment for many students in higher education today. Rows upon rows of students and larger lecture theatres may facilitate more students but they are hardly conducive to conversation, let alone critical thinking and active learning. While a growing number of US and European universities are redesigning their learning spaces to accommodate more active forms of learning (NMC Horizon Report, 2016), the typical arrangement is what Shaw (2015) calls 'The Cemetery Method' - the practice of arranging classrooms that is similar to cemeteries in that students typically remain seated in fixed rows. She claims that while this approach may have worked in the 19th century, the demands of 21st century society are very different and require learning spaces to enable greater interactivity.

While there are many elements that might contribute to a successful learning space, a collaboration-friendly learning space (sometimes called an active learning classroom) typically demonstrates a number of characteristics such as round tables and no obvious 'top' of the room. According to active learning space researcher JD Walker (2014), such rooms are more conducive to group work, problem solving, and concept application. This reinforces ideas mooted by Chickering and Gamson (1997) who in their seminal paper on undergraduate education wrote that: "Learning is not a spectator sport… [Students] must talk about what they are learning, write about it, relate it to past experiences and apply it to their daily lives. They must make what they learn part of themselves."

Fortunately there are a growing number of design guides, papers, and toolkits available to inform the learning space design process and these are starting to pay greater attention to pedagogical considerations. In 2007, JISC were one of the first UK organisations to develop a guide on evaluating and designing learning spaces that provides a detailed framework for the development of educational environments to support more collaborative learning. More recently, the UK Higher Education Learning Space Toolkit was published in February of this year (2016). It provides pragmatic, experience-based guidance for Audiovisual, IT and Estates teams, and places particular emphasis on exploring pedagogical principles and their place in learning space design. Drawing on the Australian experience, Keppell, Souter and Riddle (2011) suggest seven principles of learning space design to support the creation of learning environments that are student-centred, collaborative, and experiential.

As these guides and toolkits illustrate, there is a vast array of features that could potentially be addressed in a learning space redesign. Much of the learning space literature to date has highlighted the use of flexible structures and furniture, group desk arrangements, and enhanced computer display options to facilitate learner-focused rather than teacher-centric pedagogies (Blackmore et al. 2011). One recent study of instructors in over 20 studio-style classroom configurations found two particular features to be perceived as "most helpful": tables that facilitate group interactions and greater availability of whiteboards for students (Knaub, Foote, Henderson, Dancy & Beichner 2016). Fisher and Newton (2014) also sought to evaluate a number of next-generation learning spaces and found strong evidence of peer tutoring, team working, and a combination of formal and informal learning taking place in a selection of group-oriented, highly adaptable settings.

The concept of connectedness and its critical importance to the modern learner is also growing louder in learning space research. Much of this discussion is evolving but it is clear that multiple mobile devices are being used in class, they are being used for both for class and non-class related activities (McCoy, 2016) and students like to use their own devices (Conole, 2008). As far back as 2002, Van note Chism argued that to facilitate connected and active learning, universities need to provide spaces where small groups can work on projects, whole-class discussion can take place, ideas and work in progress can be displayed, and technology can be accessed on demand. However it would seem that navigating different spaces successfully as a teacher calls for a greater understanding of the interstices between physical and virtual learning spaces. Savin-Badin and Falconer (2016) suggest that the age-old philosophical concepts of metaxis ("in-betweenness"), liminality (shifting identity) and social space should be recognised in situations where elements of the physical and virtual interact. The authors stress that these are not static concepts and that exploring these ideas is essential to improving teaching and learning design. A greater understanding might ultimately assist with aspirations for the virtual and the physical spaces to "coalesce" so that the engagement and activity that is happening in the digital space flows naturally in and out of the physical space (White, 2016).

The learning space literature to date, together with initial evidence from local practitioners, suggests that altering the classroom environment to facilitate greater collaboration, mobility, and flexibility may be worthwhile. The remainder of this paper describes the approach taken at DCU to this end.

## 3. Methodology and findings

This case study describes a specific project, the Learning 21 project, focused on the development of Digitally Enhanced Active Learning Spaces (DEALS) at DCU, Ireland. This project involved collaboration between Estates, Information Systems Services (ISS) and the teaching and learning team from the National Institute for Digital Learning (NIDL).

In phase 1 of the project, an online survey was conducted to investigate how staff perceived the current state of physical learning spaces at DCU. A survey was emailed to 480 academic staff at the institution in August 2015. 129 staff responded to the survey, representing a response rate of 26.8%.

*Survey Results*

When asked about the current state of learning spaces, Table 1 shows that a minority of staff rated the state of DCU's lecture theatres and classrooms as "good" or "very good". Most of the responding lecturers described the facilities as being somewhere along a spectrum of adequate to very poor. The flat classroom spaces were viewed particularly negatively with 24.39% of lecturers rating them as "Poor".

**Table 1:** How staff rated the current state of DCU's learning spaces in 2015

**Overall, based on your experience how would you rate the current state of DCU's learning spaces?**

Answered: 125 Skipped: 4

| | Very Good | Good | Adequate | Poor | Very Poor | Total | Weighted Average |
|---|---|---|---|---|---|---|---|
| Lecture Theatres (i.e., tiered spaces) | **4.39%** 5 | **23.68%** 27 | **48.25%** 55 | **17.54%** 20 | **6.14%** 7 | 114 | 2.97 |
| Classrooms (i.e., flat spaces) | **1.63%** 2 | **25.20%** 31 | **43.09%** 53 | **24.39%** 30 | **5.69%** 7 | 123 | 3.07 |

In the survey, a question was asked on preferred designs, configurations and technologies for DCU's learning spaces. Table 2 shows that flat classroom spaces were rated as the highest priority for future developments with 42.6% of lecturers voting them an immediate priority.

**Table 2**: Spaces rated as highest priority for redevelopment

**What do you see as the highest priority in terms of the future development of DCU's physical learning spaces?**

Answered: 115 Skipped: 14

| Answer Choices | Responses | |
|---|---|---|
| Lecture Theatres (i.e., tiered spaces) | 31.30% | 36 |
| Classrooms (i.e., flat spaces) | 42.61% | 49 |
| Computer Labs | 6.09% | 7 |
| Other (please specify) | 20.00% | 23 |
| **Total** | | **115** |

In particular, when asked about preferences for furniture type within such classrooms, results indicated a strong preference for flexible furniture whereby tables can be easily moved, joined up, or folded up as required. 42.4% of respondents voted for flexible furniture options.

**Table 3**: Flexible furniture rated highly

**In the future for your teaching what is your main preference for the type of furniture that should be available in DCU's classrooms? (i.e., flat spaces)**

Answered: 118 Skipped: 11

| Answer Choices | Responses | |
|---|---|---|
| Fixed furniture in rows | 5.93% | 7 |
| Fixed furniture in a U shape | 3.39% | 4 |
| Fixed furniture for small group interaction | 4.24% | 5 |
| Flexible furniture where tables can be moved, joined or folded up as required | 42.37% | 50 |
| Combination of fixed and flexible furniture in different classrooms depending on size | 34.75% | 41 |
| Other (please specify) | 9.32% | 11 |
| **Total** | | **118** |

*Development Phases*

The size of the task quickly became apparent and a multi phased project emerged. It was agreed that the first phase of development should focus on developing three showcase learning spaces to facilitate both collaborative and technology-enhanced learning.

To guide this work, the project stakeholders decided to refer to Keppell et al.'s (2011) seven broad principles of learning space design. Chosen for their flexibility and relative ease of interpretation by a multi-faceted project team, these principles state the need to design a space for:

- **Comfort**: a space which creates a physical and mental sense of ease and well-being.
- **Aesthetics**: pleasure which includes the recognition of symmetry, harmony, simplicity and fitness for purpose.
- **Flow**: the state of mind felt by the learner when totally involved in the learning experience.
- **Equity**: consideration of the needs of cultural and physical differences.
- **Blending**: a mixture of technological and face-to-face pedagogical resources.
- **Affordances**: the "action possibilities" the learning environment provides the users, including such things as kitchens, natural light, Wi-Fi, private spaces, writing surfaces, sofas, and so on.
- **Repurposing**: the potential for multiple usage of a space

The photograph below illustrates one of the rooms in its original configuration.

**Figure 1**: One of the original classrooms

Table 4 below outlines how it was redesigned with respect to the seven principles.

**Table 4**: Approach compared with Keppell et al.'s 7 Principles

| Principle | Weaknesses in original space | How weaknesses were addressed in upgrade |
|---|---|---|
| Comfort | A pull-down projector screen in front of one blackboard, restricting teaching options and view<br>Teacher's table at the front away from the wall<br>Limited fluorescent lights | Fixed projector screen installed. Blackboard removed and replaced with three whiteboards, spread around the room to aid visibility and invite collaboration<br>Podium located in the corner<br>Touch screen panel added to podium to control lights, projector, and audio volume<br>LED lights installed |
| Aesthetics | Power sockets on the wall with on/off button for the projector<br>Damaged button panel for projector<br>Trailing cables<br>Drab wall colours and flooring<br>Visible and noisy pipework | Same podium in every classroom branded with the DCU logo<br>Touch screen panel built into podium<br>Trailing cables removed/hidden<br>Vibrant wall colours, new carpets<br>False ceiling to cover visible air conditioning pipes |

| Principle | Weaknesses in original space | How weaknesses were addressed in upgrade |
|---|---|---|
| Flow | Seating difficult to move/adjust<br>Heavy tables, hard to move | Space for free movement around the room<br>Round collaborative tables with flexibility to adapt<br>Tables are on wheels |
| Equity | Teacher positioned as 'sage on the stage',<br>Only teacher had access to screen<br>Limited space for wheelchair access<br>Unequal viewing access | No obvious 'head' of the room<br>Wireless projection via *Airmedia* technology means that students can broadcast from their own devices. Up to four devices can be displayed simultaneously.<br>Accessible touch screen for lecturer with 'how to' information readily available<br>Every student is able to see every other student<br>Additional space for wheelchair access<br>Room booking panel outside some rooms<br>High resolution projectors to increase visibility for all |
| Blending | Limited collaborative opportunities<br>Option to use whiteboard or blackboard only | *Airmedia* wireless technology enables easier sharing of ideas/progress by students and feedback from teachers<br>Four additional whiteboards installed to facilitate both didactic teaching and group work |
| Affordances | Limited opportunities to support student-owned learning devices<br>No power plugs for students | Each podium is equipped to facilitate mobile lecture capture kits<br>Room is well equipped for BYOD<br>A "breakfast table" type board attached to the back wall. This board has 4 double sockets each of which contains two normal plug sockets and two usb sockets. This is promoted as a "charging table". |
| Repurposing | Limited opportunities to reuse the static classroom facilities for other purposes | As the tables are on wheels the room can be quickly emptied and used as an exam hall |

The figure below illustrates how the classroom was transformed.

**Figure 2**: Newly redesigned DEALS classroom

*Initial Feedback*

Initial feedback on the changes to the flat classroom has been very positive. Below is a sample of some of the comments made by staff who teach or support teachers using the redesigned spaces. It is worth stating that this feedback was unsolicited and was emailed to the project team in response to very positive experiences of teaching in the upgraded space:

> *"The work you guys did on C167 is amazing. I had two classes in there yesterday, we used all the whiteboards, we moved the tables to be a u-shape for the start then back to the circles. It was quick and easy and the 'Air Media' thing sounds superb, I can't wait to have the freedom to move around and teach."* ***Lecturer***

*"Those who are not timetabled [there] would like to be and some have described it as 'a perfect set-up for teaching'.* ***Assistant Dean of Teaching and Learning***

*"…it will be my favourite room, I am delighted that one of my classes is timetabled there. The ability to display student devices makes it so easy to manage student presentations."* ***Lecturer in Communications***

*"having the dual projection is ideal for maths teaching, display the problem on one screen and then work through the solution on the other"* ***Lecturer in Mathematical Sciences***

*"The intuitive nature of the touchscreen panel makes it easy for the lecturers to use, which has helped reduce calls to our helpdesk"* ***ISS staff member responsible for classroom audio-visual support***

In describing the limitations of this paper, it should be stated that results cannot be considered generalisable. A more comprehensive evaluation framework has not yet been applied; therefore the evidence above is somewhat anecdotal. However it does represent a starting point that suggests more in-depth research would be of value in determining the actual pedagogical impact of redesigned spaces.

## 4. Discussion

While the initial positive feedback seems to validate the changes made, there were some weaknesses in the approach taken in the light of recent literature. The rooms were planned and redesigned quickly (from survey to implementation in under six weeks) without considering all the frameworks that might be suitable, particularly those with a strong pedagogical focus. The 7 principles from Keppell et al., while very helpful as a tool for decision-making that is accessible to stakeholders from different backgrounds, do not explicitly set out to inform pedagogical best practice. To capture what potentially contributes to successful teaching and learning, the authors contend that a number of additional principles, frameworks, and approaches should be considered when designing and subsequently teaching in new spaces:

The design principles outlined in the UK Higher Education Learning Space toolkit (2016, pp 10-12) look particularly promising for helping stakeholders to plan spaces that may be very different to those they have experienced themselves. While there is some overlap with the 7 principles discussed earlier, these principles (outlined below) raise the bar of what might potentially be created, and speak more directly to positive and inclusive pedagogical practice. Because the principles established at the outset fundamentally drive the overall design, these principles and their implications should be thoroughly explored by the project team:

- Create a sense of community and encourage participation - students should feel they belong to a learning community, with opportunities to connect and collaborate in a physical setting and online
- Integrate and connect learning - there should be seamless integration between formal and informal learning spaces and between group and individual learning. Integration of physical and virtual learning resources and activities needs to be considered as part of overall space design
- Meet a range of different learning needs - furniture that is easily configurable, controllable lighting, and low tech options ensure facilities are appropriate for a variety of learner needs
- Offer a comfortable working environment - temperature, noise levels, lighting, spaciousness, odours, and student work areas (such as writing surfaces) all need to be carefully considered and managed
- Make effective use of technology - access to a wireless network is a must in order to enable students to chat with friends, meet people, share digital content, and explore new ideas
- Be inclusive and sustainable - consider the needs of disabled students and staff, and create a welcoming environment for international students while considering environmental impact of proposed facilities
- Involve, inspire and motivate students - finding meaningful ways to involve students in planning and evaluating space design is critical, and seeking to 'delight' students should be a core aim

Based on the DCU experience, the authors agree that involving students more closely in the process from the outset is more important than ever, and would add that the need to involve academic champions from the start is similarly desirable.

Ling and Fraser's (2014) framework could serve as a guide to good pedagogical practice that may be of particular value to teaching staff. The table below, extracted from p. 79, provides a suggested pedagogic framework for use when teaching in next generation learning spaces that merits further consideration.

**Table 5**: Pedagogic framework for use in next generation learning spaces

| **Learning Spaces Need to Provide** | **Learning Activities Need to be** | **Learning Activities Need to Involve** | **Learning Activities Need to Facilitate** |
|---|---|---|---|
| Rich learning environments that reflect the real world so are authentic, complex and use technology appropriately | Student-centred<br>Focused and outcome oriented<br>Connected<br>Challenging and facilitate individual meaning making | Active learning<br>Social interaction<br>Provision of guidance and feedback | Selective engagement<br>Critical Engagement<br>Application |

On the vital point of evidence as to what is working (or not) in a redesigned space, the authors recognize that it is essential to observe how students and teachers are using the space, as the following research advises:

> *"Observing what students actually do—how they move in, inhabit and reconfigure space, how they create congenial learning places, how they assemble tools and other artefacts in their work as students—is the best way of gaining insights into likely mechanisms; so too is talking*
>
> *with students (and teachers and other stakeholders) to gain their sense of what they*
>
> *are doing and why, how they experience different spaces, what they believe to work*
>
> *best for them, in each of the diverse activities making up their studies. Combining observational and experiential data is still relatively rare, yet vital." (Ellis & Goodyear, 2016, p. 33).*

Employing a range of information-gathering approaches could shine a light on the actual student experience and help to identify if indeed next-generation or active spaces are contributing to student learning outcomes. These approaches might include observation of sessions, focus groups, reflections (both lecturer and students), video diaries, blogs, and time lapse photography as suggested in the UK Education Learning Space Toolkit (2016).

As Keppell, Souter & Riddle (2012) state, there are significant challenges regarding the professional development of teaching staff that must be considered. Teachers will not necessarily know how to leverage the opportunities that a space affords and there need to be opportunities to learn what can be achieved. "Spaces which offer a rapidly expanding range of technologies and configurations confront traditional assumptions about teaching and learning. In turn, this creates challenges for teachers working in these new spaces to re-imagine their teaching, learning designs and practices and actively promote more student engagement in the learning process." p. 243 Keppell et al. have developed a three-stage model of academic development activities to support those teaching and learning how to teach in such environments. Stage 1 probes teachers' pedagogical and technological beliefs. Stage 2 is designed to help teachers envisage learning designs that are appropriate to the space(s) and their own disciplinary context. Stage 3 is focused on consolidating and applying those designs, enacting leadership, and sustaining community learning on an ongoing basis. Based on the specific examples of professional development initiatives described, such an approach could potentially be very powerful for re-imagining teaching in collaborative learning spaces.

To ensure the needs of stakeholders are being met, there could be greater use of baselining to facilitate pre- and post-evaluations. A baseline is a start point against which it is possible to demonstrate that a project has delivered a tangible improvement. Establishing a baseline at the pre-occupancy stage helps to document the current state of play before attempting to change it. It includes identifying how you will measure improvement and what sources of evidence will be collected in order to verify the success or otherwise of the project.

## 5. Lessons learned

The following is a brief summary of some of the lessons learned throughout the project which may be of interest to others contemplating similar initiatives:

- Communication with staff is vital and consistency is key. A project goal is for lecturers to have the same experience regardless of the building that they are in.

- Stakeholder availability can be an issue for an integrated design approach.
- Blackboards are still in high demand, particularly from maths lecturers and sometimes collaborative furniture can be an issue for room usage (unsuitable for exams, for example).
- The limitations on space mean that we are restricted on what redevelopment we can do with regards to furniture as we need to take account of end-of-semester exams.
- The process is a collaborative process and involves people from IT Services, Estates and Teaching & Learning. It can be challenging to involve all stakeholders over time.
- Students and lecturers should ideally be involved from the start.
- As always, funding is a constant issue so the more evidence that can be provided regarding return on investment, the better for all involved

## 6. Conclusions

The findings of this case study would suggest that relatively small-scale changes to a learning space can have an impact on teaching and potentially inspire new forms of interaction between students and teachers. The next phases of the project involve further developments, including the intention to pilot new collaborative chairs (Senator Ad-Lib Scholar) in a number of unusually shaped environments and the design of two 'Learning Futures Labs' as innovation classrooms for exploring, harnessing and shaping the future of new generation learning spaces. However redesigning a space for 21st century learning does not automatically guarantee that more sophisticated forms of learning will take place at that location. To inform future developments stakeholders need to discuss and potentially rethink the guiding design principles, focus more deeply on pedagogy, conduct observations to develop a better sense of how spaces are being used, and consider the implications for ongoing academic development. These ideas warrant further discussion with the project team before the next phase of development commences. Future research will focus in on these elements.

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# A Pedagogical Design for ICT-Supported Cross-Age Peer Interaction

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**Abstract**: The present paper is an account of a design-based action research study. The research question focused on how to create a pedagogical concept for ICT-supported peer interaction that enabled cross-age students to share experiences and knowledge in relation to internships. Internships in higher education are a natural booster of the elusive concept of professional identity. Students return from internships with a better understanding of what they do, know and are professionally. The learning that takes place for the intern remains individual and is only shared with a supervisor. The present study is based on the idea that internship students' individual learning could be shared with younger peers through online interaction. In the context of a bachelor programme in Northern Denmark, the concept was implemented as discussion forums embedded in the local LMS. In these forums, the students engaged in discussions of professional matters and accounts of daily practices in internships. The analysis of the forum interactions, a survey and a focus group interview revealed that the students perceived the concept as a meaningful activity. The key findings centered on issues regarding: responsibility, relevance and roles. The students felt a strong sense of responsibility toward each other in providing meaningful content and frequent activity and replies to posts, which served as a source of motivation. The question of relevance relates strongly to the timing of the activity, as well as clear expectations and purpose. To the cross-age students, tutor/tutee roles could have provided further direction and purpose of the interaction, but this was not initially part of the concept. This research gave insight into the creation of a pedagogical cross-age concept supported by ICT that could benefit practitioners and researchers in higher education.

**Keywords**: computer supported collaborative learning, cross-age peer, peer learning, peer interactions, professional identity, communities of practice, internship, higher education

## 1. Introduction and context of study

In the fall of 2015, 46 5th semester students enrolled in a bachelor programme in experience economy and tourism left the safe environment of their education to fill out internship placements at public and private corporations both locally and internationally. Meanwhile back home at the programme 52 new 1st semester students started their learning journey. Their daily life consisted of classes, assignments and project work - in many ways segregated from the real world outside campus. It is a well-known mechanism that internships are a natural booster of the somewhat elusive concept of professional identity. From a socio-cultural perspective, the development of a professional identity is an on-going process that is social in nature and negotiated in communities of practice (Wenger 1998). This position supports internships as an educational activity. Interns participate in the community of practice of the internship host, thus for a period becoming a member of that community. In this process, the interns negotiate their identity as professionals. This identity negotiation is part of each student's individual learning trajectory. Despite – but not ignoring - the social nature of identity development, the learning that takes place for the intern remains individual and is typically only shared with a supervisor. The 5th semester students' return from internships with a better understanding of what they do, know and who they are professionally (Dehing, Jochems & Baartman 2013). The pedagogic design described in this paper is based on the assumption that it is relevant and desirable for the 1st semester students to gain an insight into 5th semester students' internships, and thus expand their knowledge of jobs, tasks and competences needed in a professional life of with the multitude of possibilities it offers. This paper describes the interactions in an online learning environment that sought to enable internship students at 5th semester and younger students at 1st semester to interact in a discussion of their professional identity.

The programme, which forms the context of study, educates students to plan, manage, and carry out events and communication tasks in public and private businesses within experience economy, including tourism. It is a three-year programme of six semesters, and the 5th semester is dedicated for internships. Previous internship hosts (and employers) include zoos, advertising agencies, libraries, public offices, museums, event agencies, tourist agencies, etc. Opposed to the classical and semi-professions such as doctors, lawyers, nurses and teachers, this group of professionals operate in a labor market characterized by interdisciplinarity and project work. Krejsler referred to this group of professionals as *competency nomads,* indicating that their loyalty in their work life is directed at the present task, workplace and employer, rather than a vocation or calling (Krejsler 2006, Krejsler, Kryger & Ravn 2007). For the students, their insight into this very diverse practice is solely based on a single internship that might provide a unique, concrete learning experience, but is limited in its singularity. Allowing 1st semester students to catch a glimpse of several 5th semester internships thus become all the more relevant.

Research results by e.g. Perry (2012) and Duemer et al. (2002) support the importance of peer interaction in relation to professional identity. In his paper, Perry uncovers the processes through which American mental health master students in supervision are able to construct their professional identity through synchronous online activities. The study by Duemer et al. show the community formation and professional identity development by engineering students through reading and online discussion of professional issues. De Smet et al. (2008, 2010) introduced the concept of cross-age peer tutors in an exploratory study students participating in cross-age peer activities in online discussion groups. De Smet describes cross-age peer tutoring as the activity where older and more knowledgeable students tutoring younger students (De Smet, Van Keer & Valcke 2008). Thus, our understanding of digitally facilitated learning has its theoretical basis within *Computer Supported Collaborative Learning* (CSCL), that was initially introduced by Koschmann (1996) and described as a paradigm for the use of technology in teaching situations that unlike previous paradigms such as Computer Aided Instruction (CAI), has less focus on instruction and more on collaborative learning processes. CSCL is thus based on the constructivist theory of learning from, among others, Piaget and Vygotsky (Piaget 1968, Vygotsky 1980).

In connection to this study a state of the art article with literature review by Gro Nielsen et al. (2014), was conducted in order to investigate whether similar researches had been done before. No peer reviewed article containing all key words: Peer learning, Professional identity, Digital Habitats, Communities of practice, Higher Educations and Internship could be located in our literature review. This lead to the conclusion that the field of study is to be investigated further.

### *Professional identity*

Central for the initial research was professional identity, which in many ways refers to an understanding of what constitutes the professional. The professions and, thus the consideration of the professional, traditionally refers to classical fields in universities like law, medicine and theology. Today the concept also refers to what can be called half- and semi-professions, like teachers, nurses and other longer educations (Staugaard 2009). According to Nygren & Fauske the definition and comprehension of the professions has developed from the "traditional professional research" to a more "practice situated" understanding (Nygren, Fauske 2010). The traditional research in professions is represented by among others Talcott Parsons (1968). The traditional understanding is characterized by a functionalistic perspective that understand the profession as groups of people with specific characteristics, like for instance: a long education, a theoretical foundation, a common language and ethics as well as a monopoly of performing within a specific area. A newer perspective is the practice situated understanding where focus moves from the specific characteristics to an interest in organisation and practice of the workplace and how it influences the professionals. This perspective results in a change in the profession research where focus is shifted from a specific occupational group to look at professional types, which are defined on the basis of their material terms (Freidson 1986).

Krejsler introduced the concept of competency nomads, who redefine themselves and their professional identity continuously throughout their career by forming alliances with different actors in order to solve the current assignment. It is the competencies, not the education, that are important (Krejsler 2006). The competency nomads and their identity development are the aim of this research. The constant redefinition of function, identity and professionalism pulls threads to Giddens, who view identity development as an ongoing condition of life in the postmodern society (Giddens 2013).

### *Learning*

The development of professional identity can be understood as a learning process, which takes place over time through participation in different communities of practice. This is a constructivist perspective on learning. Central for this research are Lave and Wenger who understands learning as situated, which refer to the social processes that can facilitate learning (Lave, Wenger 2004). In this context, learning is an identity developing project for the participants in a community of practice. When looking at a broader category or professions that are not uniquely defined identity is created across multiple communities of practice. All human beings have activities in different contexts and are all members of multiple communities of practice at the same time. It is within the communities of practice that we get experiences, give meaning to our actions, create our identity and learn. It becomes interesting for us to research how students construct meaning.

*Digital habitats*

Another central concept for this research is digital habits, which provides us the frame of our perception of the dynamic collaboration between the digital framework and the community as a process. Through technology it is possible to impact the virtual community as well as the activities of the community can impact the technology and the activities that it makes possible (Wenger, White & Smith 2009). Wenger points out that like the shaping of a biological habitat is impacted by and reflects the learning of the species so is the digital habitat not solely a configuration of technologies, but a dynamic mutual defining relation. Wenger suggests four perspectives that impacts how technology can be the framework of an online community of practice: *tools* that supports the specific community activities, *platforms* into which vendors and developers package tools, *features* that help make tools and platforms usable and "liveable" and *full configurations* of technologies that sustain the habitat. The four perspectives all seems relevant to include in an analysis of how a digital habitat and the technologies that are integrated in it, can function as a frame to support the creation of professional identity.

*Professional identity and online learning*

C. Wayne Perry (2012) emphasizes that students from the online classes experience that the online environment contributes to their professional identity. Through the online setting the students get insight into other and radically different contexts than the current one they are in. Perry uses the concepts by Mark Prensky (2001) about digital natives and digital immigrants. The research indicates that the online environment benefits that development of professional identity for digital natives. Both digital immigrants and digital natives' experiences that there professional identity is created through "peer relationships", but digital immigrants still feel that they gain more out of personal contact in a traditional way.

This lead to the research question guiding the present study which focused on how to create a pedagogical concept for ICT-supported peer interaction that enabled cross-age students to share experiences and knowledge in relation to internships.

## 2. Research design, methods and analysis

The study reported in this paper was conducted from the middle of September to the end of November of 2015 where 5$^{th}$ semester students had initiated their 20 week long internship and 1$^{st}$ semester started their study time at the programme. A Design-Based Research (DBR) methodology provided a frame of reference for the research design. Introduced by e.g. Brown and Collins, DBR is an attempt to create an approach to research in learning that is both scientifically credible and applicable in learning practices (Brown 1992, Collins 1992). DBR studies are, among other things, characterized by a close involvement of the researchers and developers with study participants in continuous cyclical activities of testing and optimizing design. Following this iterative approach, the pedagogical design described in this paper is based on two previous cycles of experimentation. Both previous cycles has had a major impact on the shaping of the current design. The first iteration emphasized a preference for asynchronous interaction in a long-term perspective, enabling a higher taxonomic level. The second iteration underlined the importance of ensuring relevance through a foundation in curriculum, as well as choosing a digital platform that students perceived as functioning and acceptable (Horn et al. 2014).

This foundation enabled the design of the current pedagogical concept for ICT-supported peer interaction. An online forum on the organizational Learning Management System (LMS) was created. With the choice of the LMS as the platform for the experiment, it was the intention to create continuity and familiarity for all learning activities. However, this desire for continuity and familiarity was challenged by a top-level organizational decision to replace the existing LMS with a new one simultaneously with our activities. A decision was quickly made to initiate the activities on the new platform to ensure that the pedagogical design would be adapted to future conditions, and that the 1$^{st}$ semester students did not have to familiarize themselves with two different LMS's. This, however, caused the 5$^{th}$ semester students to have some difficulties with the new LMS. Six groups were created in both the Danish and International program. Each group had 3-5 members from respectively 1st and 5th semester, thus ranging from 6-10 members per group. This group size was based on considerations of the intimacy and anonymity - both themes deducted from previous research cycles. The groups were each assigned an individual forum in which the activities were to be performed. Based on the experiences from previous experiments we wanted to reduce the complexity of the assignments. Thus, we designed student assignments on a lower level of reflection in the beginning, and slowly increased the complexity and demands of tasks. The first task for every student was to make a video presentation, so everyone was able to put a name and face on the people interacting in the discussion groups. Next line of tasks was weekly updates from the 5th semester students and weekly questions from the 1st semester. Halfway through the semester, the 1st semester students were to interview the 5th semester students and write an article based on these interviews thereby increasing the level of reflection. It was of great importance to ensure integration of the online activities in the curriculum of the given semester, both to create motivation and to avoid that the activities would be perceived as an extra and burdensome task. This was attempted by integrating the online activities in already scheduled lectures on the 1st semester. Similarly, it was the intention that the 5th semester students would be able to use the reflections in the forum in preparation of a report for their internship exam. The fact that one of the research group members is the programme coordinator and assistant professor at the programme secured a close connection with the programme. This gave the research group a unique opportunity to design facilitative activities both online and during lectures.

Over the course of the three months, the students produced a total of 233 posts/replies on posts, 45 presentation videos and 8 articles. Not all groups were equally productive, but none were completely silent. In order to evaluate and reflect on the outcome of the research questionnaires were sent out to both 1st and 5th semester students and 56 replied. Based on the result of the survey a focus group interview was performed with one of the groups that had had a high level of activity, as we were interested in investigating what made it work. The content produced in the groups, the survey and the interview combined with our observations as active researchers in the on-going experiment make up the data for this paper. The method of analysis applied was inspired by Strauss and Corbin’s approach to Grounded Theory (1994). The authors of this paper studied the data through a repetitive practice similar to Peirce’s abductive reasoning (Peirce 1992). These studies were iterated in a process wherein all researchers examined the data until relevant and likely themes appeared.

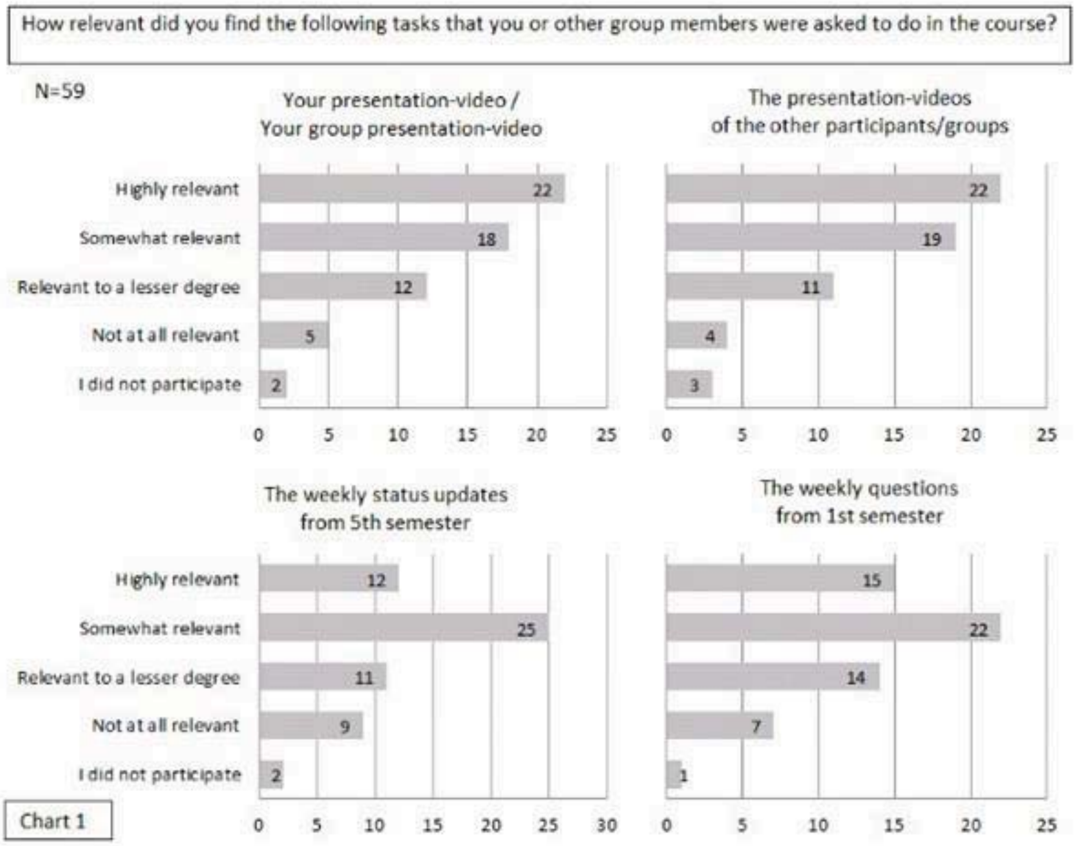
## 3. Results and discussion

The adaptation of the concept and the general level of student activity depended highly on whether or not the pedagogic design and activities were perceived as relevant. In comment boxes in the survey, several of the participating students described the fundamental idea as relevant. Several students saw it as a “great” or “very good” idea. A recurring comment however was the limited activity in the forum, recaptured in this quote: “*I think that it's a great idea but for several reasons it didn't work out as it could have. Mainly because participation (in my group) was quite low”*.

In the survey there were several critical comments on the use and the organization of the content in the LMS which was new to both students and researchers. This was commented as a barrier reducing the outcome. The number of students rating the LMS to be “highly” or “somewhat” accessible and easy to use was a little higher than those finding it accessible to a lesser degree or not at all accessible. On one question; finding the right place to post questions more students found it accessible to a lesser degree or not at all accessible. The challenge of getting familiar with the new LMS thus seems to be part of the reason for the low level of activity some of the forum groups.

In the focus group interview, the participating students reported a strong sense of responsibility toward each other in providing meaningful content and frequent activity and replies to posts, and this served as a source of motivation. 1st semester students felt obliged to ask meaningful questions, but felt they did not have sufficient insight to do so. They suggested that moving the activities to the 3rd semester would probably enable them to participate on a more appropriate level. They expected that their progression in semesters would impart them with a basic overview of the programme specific theories and methods, thus enabling their ability to ask relevant questions. This could be perceived in line with Lave and Wenger’s concept of shared repertoire (Wenger 1998). In this understanding, students’ intention to participate on an appropriate level could be seen as an intention to ask questions that correlates with a shared repertoire of stories, tools, and ways of addressing recurring problems. The participating 5th$^{th}$ semester student in the focus group interview reported that some 5th semester students felt it as a burden to be obliged to participate in the forum activities and some found it difficult to figure out which experiences would be interesting for the 1st semester students. Furthermore, there seemed to be different views on the balance between commitments to the internship host and students' participation in the forum activities. This corresponded well with the findings from the survey, and a review of the actual interactions in the forum. Both revealed a fluctuating level of activity and participation.

In the survey, the students were asked to evaluate the relevance of the video presentations they produced, presenting participants and groups. The 5$^{th}$ semester students were furthermore asked to evaluate their weekly status updates, and the 1st semester students were asked to evaluate the relevance of posting weekly questions (Chart 1). According to the survey, the majority of both 5th semester and 1st semester students experienced the videos as relevant. "Highly relevant" received the highest score and combined with "somewhat relevant" these answers accounted for more than two thirds of the answers. The majority of students also regarded the weekly status updates and questions as relevant, but here the most frequently used answer was "somewhat relevant".




This was further investigated in the focus group interview. According to the participating students the question of relevance relates strongly to the timing of the activity, as well as clear expectations and purpose. The 5$^{th}$ semester students perceived it as a challenge that some were nearing the end of their internship when the forum activities began, and found that the weekly status did not make sense to them. Others were just at the beginning of their internship and also found it challenging to provide meaningful contribution when their level of knowledge about their community of practice was limited.

Comments from the survey furthermore revealed that the interdependence between 1st and 5th semester students led to frustration in forums where there was a low level of activity. In the focus group interview, the cross-age students stated that clearly defined tutor/tutee roles could have provided further direction and purpose of the interaction, but this was not initially part of the concept. Both 1st and 5th semester students provided arguments for defining roles, because they did not consider each other as equals in this context. The 5th semester students were considered to be the ones who deliver content, while 1st semester students' roles were reduced to asking questions. One 1st semester students said: *"1st semester gain 40 times more out of the concept, but 5th semester has 40 times the workload"*. This confirms that the division of labour is not considered to be equal, though it was initially the intention on our part.

5th semester students also considered it to be a motivational factor if teachers or internship supervisor was present in the forum to help with discussions, theoretical input, etc. This was not something the 1st semester asked for, but none of them saw it as a hindrance for their participation. In relation to the roles the sizes of the groups were discussed. One way to secure that everybody got something out of the concept is to make every student being present in one big group instead of multiple smaller. The students were not that concerned about sharing sensitive information in a big group, but preferred the smaller groups because of the nature of assignments. Furthermore, in smaller groups students felt they made new acquaintances that could be pursued on future occasions.

The assumption that it is relevant and desirable for the 1st semester students to gain an insight into 5th semester students' internship proved to be legitimate. The online learning environment enabled cross-age students to interact in a discussion of their professional identity although not all groups were equally active. In some cases, 5th semester students, who either didn't see the tasks as meaningful enough or felt that they didn't have enough time, caused inactivity. This might have been anticipated by a better preparation for the role they were expected to fulfil, as well as clear curricular connection to the learning objectives of the internship. In other cases, the 1st semester students did not participate. One might question whether 1st semester students have sufficient prerequisites to participate in the activities. Referring to Wenger (1998), the scaffolding in the pedagogic design did not allow them to have a legitimate peripheral participation. Our attempt to create an environment of equal participation, instead led to confusion and in some ways a lower level of activity.

## 4. Recommendations and reflections

This study gave insight into the creation of a pedagogical cross-age concept supported by ICT that could benefit practitioners and researchers in higher education. The concept of discussing professional topics with cross-age peers is a beneficial but challenging quest. This third research cycle was the first time that we succeeded in facilitating cross-age peer interaction in some of the groups. For other educational practitioners who would like to conduct to design a similar pedagogic concept, we provide the following recommendations:

- A close connection to the students on the different levels is paramount - both in practical terms and in relation to curricular activities. It is preferable if the activities are integrated into existing courses and/or replace mandatory activities on the given semester.
- Younger students need to have a certain level of understanding of the topics in order to be able to contribute to the professional conversations.
- Sufficient preparation of the students is important in order for them to see the relevance of the activities. There can be a tendency for internship students to feel disconnected from the programme and for them other activities seem like a disturbance.
- A high degree of facilitation both online and face-to-face is needed in order to secure a minimum of attendance. The concept itself about sharing knowledge was not enough to motivate the students to participate.
- The number of attendees in online groups should be considered. The consideration revolves around a balance between level of activity in the groups and the need for confidentiality. In smaller groups there is a risk for a low level of activity e.g. by an unfortunate composition of inactive students. Larger groups might be impersonal and unsafe with no possibility to be anonymous in the local context. A relationship of trust should be built even though the students might never have met each other. In this third cycle we did that by having everybody make and post a presentation video of them self and either their internship or their motivation for joining the programme. The result was several interesting and creative videos.
- It is possible to make students interact in an institutional LMS. The integrated function in the LMS we used (primarily notifications and app) motivated more students to participate. Inversely we have experience that a general dislike/distrust of the specific LMS can prevent students interacting at all.

It can be concluded that the students perceive the creation of a pedagogical cross-age concept supported by ICT as being relevant. Our experience from three cycles indicates that there is a learning potential, but that digital facilitation is complex and dependent on multiple factors.

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# Prediction Model for Success of Students at University Level

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**Abstract**: Success of university students in subjects they study could be significantly improved by a smart organization of their study plans, especially when prerequisites, i.e. formal requirements on subjects' attendance order, are not applied. Smart planning is represented by a wise choice of priorities for various duties within involved subjects. Frequently, students chose to stop attending a particular subject to gain more time for study of other subjects. However, this could lead to an extended study time or even termination of studies due to a chaining effect of failures. Subject failures are often caused by poor prioritization of assignments considering the overall assignment study load. In summary, student success is often threatened by the lack of information about the difficulty of subjects as well as proper continuity of learning required skills in a given study program. In this paper we propose a prediction model based on conditional probability constructed from historical data representing success of the students within a particular set of subjects. This model improves study success by helping the students to evaluate their capabilities and by suggesting the right choice of priorities. The proposed model includes the description of conditions and data requirements needed to provide valid predictions. The model is designed to provide information about the probability of passing a particular subject for a student considering both historical data for subjects as well as a student's personal history. The application of the model is demonstrated on a real-world study program showing some preliminary results. We note that this approach requires relatively high utilization of IT (Information Technology) support and e-learning tools, as the model itself and its possible future extensions require good quality data. This problem is also discussed in the paper.

**Keywords:** university education, student success model, subjects result interdependence, conditional probability

## 1. Introduction

Success of students in university programs depends on many factors. These factors, that include achievement motivation, academic goals, institutional commitment, perceived social support, etc. have been identified by various authors, e.g. (Robbins et al. 2004). This analysis targeted two types of student results: performance, as measured by Cumulative Grade Point Average (CGPA), and persistence, as measured by the length of time a student remained enrolled at an institution toward completion of a degree. In this study we are attempting to predict student results in subjects given the outcome of preceding subjects.

Students while learning generate large amounts of data especially while attending online courses; note popularity of Massive Open Online Courses (MOOC) (Liyanagunawardena et al. 2013) and (Baggaley 2013). However, large amount of data is also generated in regular full-time courses due to extensive use of e-learning tools. This causes rapid development of educational datamining (EDM), see (Romero and Ventura 2010), or educational social network analysis (Palazuelos et al. 2013). Educational social network analysis should be taken with care since there might be problems with correct construction of the network, including problems with using correlation (Vejmelka et al. 2015) and problems constructing time dependent networks (Hlinka et al. 2014). It is worth mentioning that data collection within e-learning tools is well supported by modern platforms for interactive classes and electronic books (Beranek et al. 2016) and (Junco & Clem 2015).

Collecting and analyzing data along with reporting of corresponding results has become an important part of what is generally called *learning analytics* (LA), see e.g. (Greller & Drachsler 2012) and (Siemens 2013). These components are usually integrated into one system called Learning Management System (LMS) (Romero and Ventura 2010). Among other functionalities, LMS provides useful feedback and recommendations for students based on their actual state and profile.

Modelling students' success and predicting their performance can be achieved in many different ways. Usual characteristics to be predicted include performance, knowledge, score or final grade. Prediction methods can be roughly divided into regression analysis and classification of categorical values (Romero and Ventura 2010). Problems arise with small datasets that make machine learning methods difficult to apply directly without preprocessing (Hämäläinen & Vinni 2006). In this study the authors use linear regression with Support Vector Machines (SVM) and several versions of naïve Bayesian classifiers. They have provided a model for predicting success of approximately 50-60 students in a target course. They have analyzed performance of students on two consecutive courses of programming and consider exercise points and final marks as features for classifiers.

There are many other methods that can be considered, see recent review in (Shahiri & Wahidah 2015). These include simple decision trees, neural networks, k-nearest neighbor and others. These methods are sometimes oriented towards detecting the strongest attribute that influences performance of students. For example, CGPA is mentioned frequently, although there are more attributes like student family background, see (Shahiri & Wahidah 2015).

There is also another area of research that analyzes, with possible help of machine learning, data from various modern tools. One of the examples is using data showing rates of access and reading in electronic resources, (Junco & Clem 2015). This could be generalized to study any interaction of students with their LMS including average time spent on completing tasks, searches for keywords, or time spent on forums (Cerezo et al. 2016). Data that originates from the web, especially data produced by interaction of students with social networks have also been used for analyses, see (Palazuelos et al. 2013) and (Kaya & Bicen 2016).

Construction provided in our model is motivated by handling specific data, typically produced at different types of colleges. Our goal is to construct a model that predicts students' performance based on data produced by LMS. Such prediction model helps the students to optimize their study effort and increase the probability of successfully completing their course by giving preliminary alert signals. The model also helps college management to predict aggregate success rates and related measures (how many students will pass the semester, how many students will attend particular courses, etc.). This model should be based on careful statistical analysis of relationships between subjects providing direct interpretation of results. Our model is represented by a process that can be understood as a toolkit that could be applied in general settings. In other words, besides the prediction capability our model could be used to learn the structure of the data and identify weaknesses for applying other methods.

## 2. Data and methods

The proposed method is valid for any students at college level. For descriptive reasons, we are presenting some of our settings for subjects usually provided at colleges with Information Technology programs.

### 2.1 Data

Our model is constructed in order to provide estimates of success for a given student in a particular subject depending on success in subjects preceding the studied one. An example of this situation is a pair of consecutive subjects called *Mathematical methods 1* (MA1) and *Mathematical methods 2* (MA2), providing essentials of mathematics needed at technical colleges and universities including those with IT courses. There is a natural interdependence between these subjects because knowledge acquired from MA1 is needed later in MA2. We have shown this dependence in **Figure 1**.


**Figure 1:** Drawing representation of dependence between two consecutive subjects. Green color denotes the predicted subject and blue color the subject having possible influence

We assume that prerequisites, i.e. formal requirements for subsequent subject, are not present or exist just in a form of formal declarations. This is not an unnatural assumption as many colleges attempt to avoid prerequisites. In addition to interconnection presented at **Figure 1,** we can also study dependences between more than two subjects. Nearly all colleges offering IT programs usually include subjects to provide abilities to handle complex algorithms that could be named *Essentials of Algorithm Design and Optimization* (ALG). To pass this subject students need to know essentials of computer programming. This suggests that there is a possible link between this subject and another subject called subject *Essentials of Object-oriented Programming* (PES). As the algorithms studied in subject ALG are more complex, students also need some essential knowledge of mathematics. We can state that success of a student in subject ALG depends success in both subjects PES and MA1, see **Figure 2**.

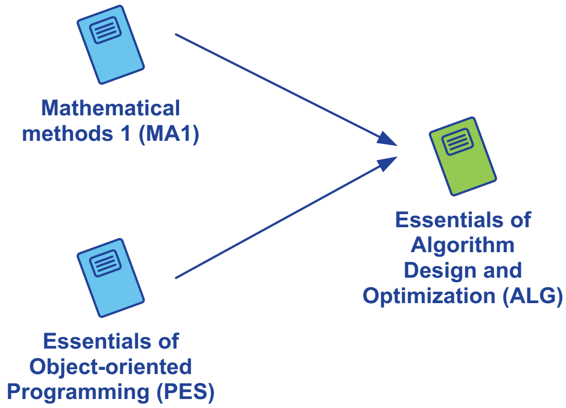


**Figure 2:** Drawing representation of dependence between target subject and two preceding ones. Green color denotes the predicted subject and blue color the subjects having possible influence

The link indicates that success of a student in subject ALG can be different for different combinations of previous successes in both subjects MA1 and PES.

We have discussed successes and failures of students up to now, but we have not quantified their results. We have also information about the final grades of students. Using grades we are not interested solely in success or failure of a student but also in their final evaluation. Let us also assume that evaluations in all subjects are using standard intervals. This means that there is the same interval of points for any subject. Students, while attending a subject are evaluated using these points continuously or during examination. At the end, each student has a final number of points ranging from zero to a given maximum for each subject.

## 2.2 Model

We propose a model built on the notion of conditional probability, see definitions in (Grimmett and Stirzaker 2001). Consider a situation where there are two subjects as in **Figure 1**. For this situation, let $X$ be a random variable representing final evaluation of students in subject MA1, and $Y$ a random variable representing final evaluation of students in subject MA2. Each of the variables can acquire values from 0 to n. As the overall task is to determine final evaluation of a student in subject MA2 with respect to their result in subject MA1, we look for a function $f$ minimalizing following term

$$\sum\left(y_i - f(x_i)\right)^2. \tag{1}$$

There is a chance that the function is linear, in which case we can simply determine link between subjects through the ordinary least square method. Since this might not be the case, another candidate for this function is conditional expectation

$$f \approx E[Y|X]. \tag{2}$$

To determine conditional expectation, we have to compute the following

$$E[Y|X = x_i] = \sum_j y_j P\left(Y = y_j \middle| X = x_i\right). \tag{3}$$

The result of this process is a function $f$ defined on a discrete domain $\{x_0, x_1, x_2, \dots, x_n\}$. To determine conditional probability, we can use directly its definition:

$$P\left(Y = y_j \middle| X = x_i\right) = \frac{P\left(Y=y_j, X=x_i\right)}{P(X=x_i)}. \tag{4}$$

Considering more general dependences, like those between subjects PES, MA1 and consecutive subject ALG described in **Figure 2**, we have to perform a slight generalization via introducing one more condition into conditional probability. Final determination of the desired function is

$$f \approx E[Y|X = x_i, X' = x'_k] = \sum_j y_j P\left(Y = y_j \middle| X = x_i, X' = x'_k\right). \quad (5)$$

To determine conditional probability using equation 4 we need to perform two computations, where calculating joint probability is the more important one. We can approximate conditional probability using the relative frequency of value $x_i$ as realization of random variable $X$ simultaneously with value $y_k$ as realization of random variable $Y$. We denote this relative frequency as $h_{i,j}$. Summing up these frequencies across $j$ provides marginal approximation $h_i$. Having a table of frequencies, indexed by $x_i$ and $y_k$ , we have to compute $n^2$ values. This could be a problem considering the potentially small number of students enrolled in a subject. The problem becomes even more evident if we add more conditions, e.g. when considering subjects MA1, PES and ALG shown at **Figure 2**. In this case we have to determine $n^3$ values and therefore the above described table could be very sparse and determining value of conditional probability would be inaccurate.

Assuming that sufficient amount of data is available, conditional expectations can be computed for a whole range of evaluation points. In situations where sufficient data is not available, we have to subdivide values of each of the random variables into several intervals and determine relative frequencies for these blocks. This could significantly improve the sparseness of the resulting table, although it brings some new problems. One of the problems is the final determination of the conditional expectation using equation 3. This is no longer possible, since we have no exact $y_j$. For equidistant sub-division of set of possible values we can use the average value $\bar{y}_j$ as a representative for the actual block. For this a new equation has to be used

$$E[Y|X = x_i] = \sum_j \bar{y}_j P\left(Y = y_j \middle| X = x_i\right). \quad (6)$$

If there is a problem populating the whole table with values, a possible solution is to use a different sub-division attempting to optimize frequency distributions. This could produce another problem with finding a good representative for a given interval. We plan to address such issues in our future research.

## 3. Results

We have included typical subjects taught at technical colleges offering IT courses. The college we are considering has about 300 students in total. It provides bachelor study program of 3 year duration. We try to show how to compute conditional expectation over the defined period of time and obtain a comparison of the modelled expectation with the actually available results from consecutive study periods.

### 3.1 Data description

The group of subjects considered for our tests consists of those we have described in section 2.1. The list contains:

- Mathematical methods 1 (MA1) lectured during winter term
- Mathematical methods 2 (MA2) lectured during summer term
- Essentials of Algorithm Design and Optimization (ALG) lectured during summer term
- Essentials of Object-oriented Programming (PES) lectured during winter term

There is another subject in the curriculum: *Web technologies* (WEB) that deals with advanced programming for Internet. This subject naturally follows the subject PES and their connection can be defined:

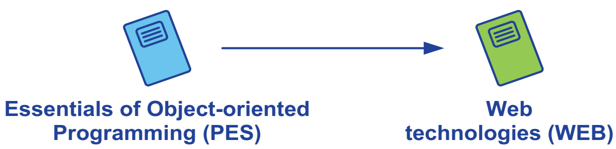


**Figure 3:** Drawing representation of dependence between subjects PES and WEB. Green color denotes predicted subject and blue color subject having possible influence

All subjects are taught both in full-time and part-time mode. Our full-time students attend their subjects weekly and part-time students attend four times per term during a weekend. Part-time students are usually older and have some job experience.

First, we calculate conditional expectation for the initial period used to perform model fitting. Then conditional expectation for test period is computed and its value compared to the value of conditional expectation for initial period. For this purpose, $\chi^2$-test is a suitable tool. We have observed during data analyses that some of the conditions are not met for the $\chi^2$-test. Especially the condition for the dataset size. Therefore, we have applied a visual comparison of appropriate frequencies. We have used 2 years (2012, 2013) data for fitting the model and 1 year data period (2014) for analysing each dependency.

Every subject has been assigned a maximum of 200 points for the overall evaluation. The first 100 points can be obtained for continuous evaluation and only those students attaining at least 60 points are allowed to attend the examination. The examination is worth 100 points and final grade is determined by the sum of continuous evaluation and evaluation of the examination. Grades are determined per **Table 1**.

**Table 1:** Relationship between evaluation points and corresponding grades

| Interval of points | Grade | Grade meaning |
|---|---|---|
| 175..200 | 1 | Excellent |
| 150..174 | 2 | Good |
| 120..149 | 3 | Satisfactory |
| 0..119 | 4 | Fail |

Due to sparsely distributed results as discussed in section 2.2, we have to subdivide evaluations into several intervals. Note that we want as many intervals as possible, as large subdivisions provide more information about the association between subjects. During analysis the following two sub-divisions are found useful, see **Table 2**.

**Table 2:** Intervals used to sub-divide dimension for evaluations. Original values range from 0 to 200

| Interval definition | | Interval denomination |
|---|---|---|
| 175..200 | 5 intervals | 1 |
| 150..174 | | 2 |
| 120..149 | | 3 |
| 60..119 | | 4 |
| 0..59 | | 5 |
| 120..200 | 3 intervals | 1 |
| 60..119 | | 2 |
| 0..59 | | 3 |

We note that sub-division into intervals as defined in **Table 2** is defined to correspond with grades definition, provided in **Table 1**, as well as with a minimum set for passing continuous evaluation.

## 3.2 Results of model

Let us start with determination of conditional expectation having one condition. As noted above, we would like to have as many values as possible. This is, however, not possible for the dataset under consideration. For this reason, we apply sub-division to 5 subintervals. Conditional expectations are shown in **Table 3**.

**Table 3:** Conditional expectations with a single condition using sub-division of dimensions into 5 intervals as defined in **Table 2** for full-time and part-time studies.

| | | Evaluations: successor subjects | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Part-time studies | | | | Full-time studies | | | |
| | | MA1→MA2 | PES→ALG | PES→WEB | MA1→ALG | MA1→MA2 | PES→ALG | PES→WEB | MA1→ALG |
| Evaluations: predecessor subjects | 1 | 2.00 | 3.38 | 3.40 | 3.27 | 1.67 | 2.00 | 1.00 | 5.00 |
| | 2 | 2.64 | 2.80 | 3.00 | 4.58 | 2.27 | 3.89 | 2.78 | 2.25 |
| | 3 | 3.36 | 4.19 | 4.05 | 4.59 | 3.29 | 3.20 | 2.50 | 4.29 |
| | 4 | 4.50 | 5.00 | 4.89 | 4.91 | 4.13 | 4.67 | 4.20 | 5.00 |
| | 5 | 5.00 | 4.94 | 5.00 | 5.00 | 4.75 | 4.82 | 4.59 | 4.80 |

Consider a pair of subjects MA1 and MA2 for part-time students. We can see that for students having results between 175 and 200 points (interval 1) for MA1 we can expect that they will have their results between 150 and 174 (interval 2) slightly skewed towards 150. We can see that having grade 1 in MA1 results in grade 2 in MA2. The expected evaluations appear to be slightly shifted towards worse values for MA2. This suggests that proposed model can represent link between subjects well for both full-time and part-time students.

The second pair of subjects under consideration, namely subjects PES and ALG, is different. For part-time students the expected results for ALG are much worse when compared to results for PES. For values in interval 1 for subject PES, expected results for ALG are in interval 3. There is a surprising value of expected results for subject ALG when results of PES are in interval 2. This value is lower than respective value when results in PES are set to interval 1. This might be caused by some unobserved influences – good students in PES are obviously divided into more groups determining their ability to pass subject ALG. We can also see that within relationship between subjects PES and ALG there is another phenomenon. For results of PES in intervals 4 and 5, respective expected results of ALG are very similar. This might suggest that we cannot distinguish these groups using our model and sub-division, the influence of the link between subjects is probably very low. This is roughly the same for pair PES and WEB.

Extreme case of this can be seen for subjects MA1 and ALG for part-time students. Expected results for subject ALG seem to depend on results of MA1 only marginally.

We test results only for dependence between MA1 and MA2 for full-time students. As mentioned above, testing goodness of fit using $\chi^2$ test cannot be applied due to lack of the data values – some of the results have less than 5 data values. Distribution of relative frequencies can be seen in **Figure 4**. It could be observed that some of the frequencies of MA2 are small or even zero for results of MA1 which makes use of mentioned test inappropriate. Note that $\chi^2$ test considers for a given result of MA1 a distribution of results of MA2. To apply the test in our case this distribution has to have enough data values for every class of result. This figure also shows approximate agreement of expected and tested distributions.

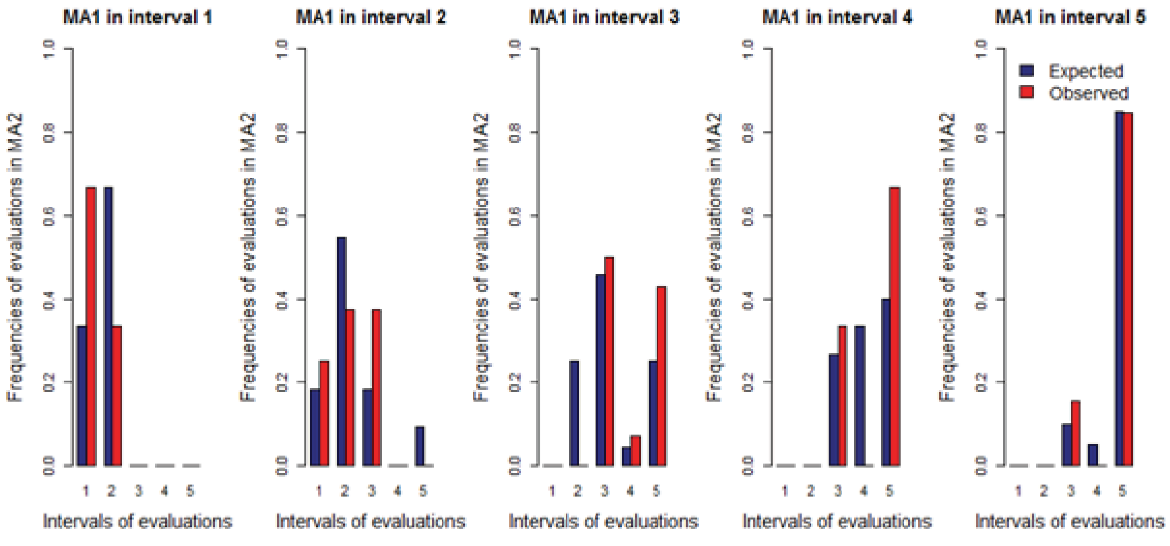


**Figure 4:** Distribution of evaluations for subject MA2 depending on corresponding distribution of results for subject MA1 for full-time students. Presented values are relative frequencies. Results are compared according to their membership in interval defined in **Table 2**

Distribution of relative frequencies as expected for subject MA2 is in agreement with observed distribution for subject MA2. There are some irregularities mostly concentrated within middle values of relative frequencies of subject MA1, see values for interval 3 of evaluations of subject MA1 and interval 2 for values of MA2. The expected value is much higher than the observed for this case. Results for other pairs seem to be less convincing, mostly because a lack of data, since there are less students studying other combinations of subjects.

As absolute frequencies for other pairs are small, we proceed with subdivisions to 3 intervals. Conditional results for all pairs of studied subjects are shown in **Table 4**.

**Table 4:** Conditional expectation with a single condition using sub-division of dimensions into 3 intervals for full-time and part-time students. Intervals are defined as shown in **Table 2**

| | | Evaluations: successor subjects | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Part-time studies | | | | Full-time studies | | | |
| | | MA1→MA2 | PES→ALG | PES→WEB | MA1→ALG | MA1→MA2 | PES→ALG | PES→WEB | MA1→ALG |
| Evaluations: predecessor subjects | 1 | 1.49 | 1.98 | 2.00 | 2.51 | 1.39 | 1.73 | 1.50 | 2.22 |
| | 2 | 2.50 | 3.00 | 2.89 | 2.91 | 2.13 | 2.67 | 2.40 | 3.00 |
| | 3 | 3.00 | 2.94 | 3.00 | 3.00 | 2.75 | 2.88 | 2.69 | 2.80 |

In this case we can see that some pairs of subjects are well represented by our model, namely a pair of subjects PES and ALG and pair of subjects PES and WEB. For both of these subjects we can see that being successful in subject PES is essential for success in the following subject. We can conclude that on average to pass subject ALG, the students need to have a final grade 1 or 2 in subject PES. The same is true also for successful passing of subject WEB. There are still some problems with distinguishing intervals 2 and 3, however our model can be used for both these pairs.

What remains is the pair of subjects MA1 and ALG that seem to have weak representation of link even for this sub-division. As noted above, there are probably some hidden influences that we should explore considering more variables. For this sub-division the visual testing of goodness of fit, similar to one given in **Figure 4**, is shown at **Figure 5**. These results are better than those obtained for sub-division into 3 intervals.

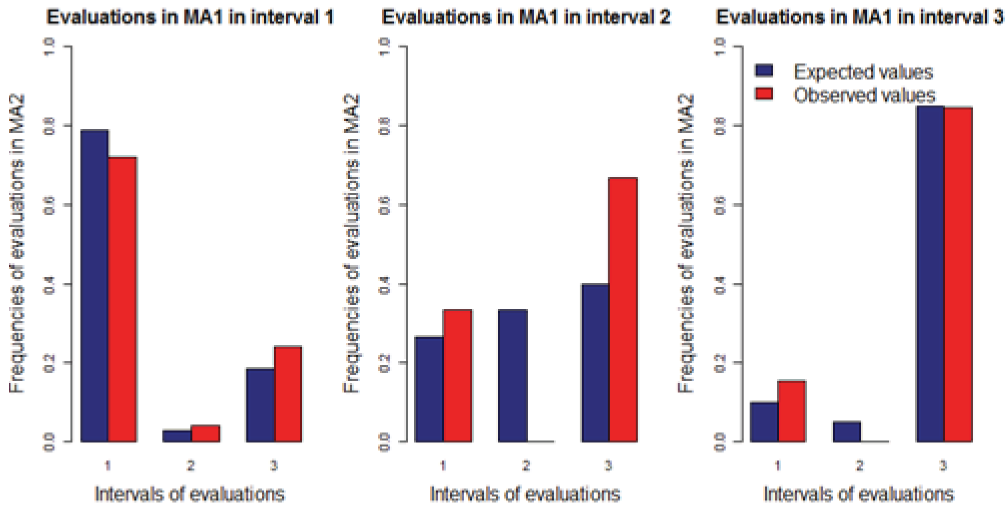


**Figure 5:** Distribution of results for subject MA2 depending on corresponding distribution of results for subject MA1. Relative frequencies are shown. Results are compared according to their membership in interval defined in **Table 2**

Considering dependence with two conditions among subjects MA1, PES and ALG we have the following results (**Table 5**).

**Table 5:** Conditional expectation of subject ALG with respect to combination of results from subjects MA1 and PES. Missing cells are not defined due to missing values of conditional probability

| | | Part-time studies | | | Full-time studies | | |
|---|---|---|---|---|---|---|---|
| | | PES | | | PES | | |
| | | 1 | 2 | 3 | 1 | 2 | 3 |
| MA1 | 1 | 2.12 | 2.86 | 2.70 | 1.18 | 3.00 | 2.70 |
| | 2 | 2.00 | 3.00 | 2.90 | - | 3.00 | 2.90 |
| | 3 | 3.00 | - | 2.94 | - | - | 2.94 |

The results suggest that for the successful passing of subject ALG we need final grade from PES to be 1 or 2. In contrast, to pass ALG we need to have at least minimum results points for passing continuous evaluations for subject MA1. For this reason, we can state that subject PES is quite essential for this combination, although weak connection of MA1 and ALG could be caused by problematic interpretation of link between subjects MA1 and ALG. For this dependence, the problem with insufficient amount of data is even more evident – for some combinations, conditional expectation cannot be computed due to zero frequencies.

## 4. Discussion and future work

We have defined a model able to evaluate expected results of students within subjects with respect to their results in preceding subjects. The model can answer questions about expected results for a particular student in a specific target subject with respect to results in past subjects. The model also provides a toolkit to analyse dependences between subjects including identification of weak links. It could be used as guidance for students in their individual study plan to predict their successes in enrolled subjects according to their study history. On the other hand, lecturers can use the model to identify weak students and support their efforts in particular subjects via early warnings. Furthermore, lecturers can use the model to analyse structure of results and their dependences. This could suggest a missing dependence or identify a group of students, according to their results in the previously attempted subjects that have underestimated the importance of informal prerequisite knowledge.

We have analysed 4 different pairs of subjects with a suggested possible link. We have shown on our dataset that we can represent this link between subjects MA1 and MA2 when sub-dividing evaluations into 5 intervals. For other dependencies, we need to apply stricter sub-division into 3 intervals. After this adjustment we are able to represent other two pairs of studied subjects, namely pair PES and ALG and pair PES and WEB. We have shown that, as expected, MA1 and MA2 have strong dependence on each other. For other pairs we have identified that subject PES is very important for success in future studies. This assertion is supported using dependence between the pair of subjects PES and MA1 and subject ALG. Subject PES has proven to be most important for success in subject ALG.

The model itself is based on conditional expectation derived from data. The main weakness of this method is sensitivity to small-sized datasets. This also includes datasets with sparsely populated large intervals of results. This can be solved by suitable sub-division of dimensions into intervals. For ease of the computation, sizes of these intervals should be approximately the same. We still have the problem to cover the whole period of results. This could be solved using sub-division taking into account distribution of frequencies. We plan to address this in our future research. These issues arise from using data from a college with small student population (300 students in total); we can assume that for colleges with larger student populations (more than 500 students) these issues will be alleviated.

To be able to test the model on *real world* results, we propose to use sub-division of values into intervals with respect to appropriate meaning of intervals, e.g. defined intervals for final grades. However, absolute frequencies might be very small or even zero for some of these intervals. In this case conditions of appropriate tests, like $\chi^2$ goodness-of-fit test, could be violated. It is worth mentioning that for larger number of students these tests are suitable. In our situation, we have used visual inspection of the results to verify the applicability of the model to *real world* situation. We plan to use more extensively the principle of bootstrapping using Gaussian mixture model in our future research (McLachlan and Peel 2004), to generate test data for the model. The proposed model has the advantage that it works directly with the data and problems with sizes of dataset can be easily identified. We also plan in our future work to augment this model with machine learning methods.

The character of the model can be considered global in sense that we are using information about dependences between subjects and not about particular progress of evaluation for each student inside a subject. It would be interesting to study models taking into account local information about the progress of each student in a particular subject. This approach, of course, requires larger amounts of data about students and their actual performance in subjects. The goal of this model would be the prediction of the performance of individual students based on the performance of currently studied subjects, performance in already completed subjects, and the specific attributes of the subjects. This takes into account their actual state and predicts their performance as function of time, i.e. how many evaluation points they are going to reach within the next two weeks. It would be interesting to study models taking into account local information about the progress of each student in a particular subject. This approach, of course, requires larger amounts of data about students and their actual performance in subjects. The goal of this model would be the prediction of the performance of individual students based on the performance of currently studied subjects, performance in already completed subjects, and the specific attributes of the subjects. This takes into account their actual state and predicts their performance as function of time, i.e. how many evaluation points they are going to reach within the next two weeks.

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# The use of Mobile Devices for the Elderly as a Possibility for Digital Inclusion

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**Abstract**: Society is constantly changing. More attention on the quality of life has led to an increase in the elderly population in recent years. Therefore, new opportunities are being offered and created to address the cultural, social, and economic changes resulting from higher life expectancy. One way to improve the quality of life would be through digital technologies, such as mobile devices. Mobile devices are ever more present in daily life, enabling the possibility of communication and interaction, as well as increasing the speed of information. Older people are increasingly seeking to learn about how to use mobile devices such as smartphones and tablets. In Brazil, the Federal University of Rio Grande do Sul (UFRGS), offers a course for seniors called TecMovI: Mobile Technologies for the Elderly. In this course the older students learn how to handle digital technologies, primarily their communication and interaction features. This article aims to map of the difficulties, abilities, and profile of the elderly who are interested in learning how to use mobile devices in the TecMovI course. The research is both qualitative and quantitative. Qualitative data was analyzed according to Bardin's (2009) methodology. Quantitative data was calculated such as the average and standard deviation. The study included 19 older adults with a mean age of 67.44 years, only 5 of which were male. The main reason participants stated that they enrolled in the TecMovi course was to learn how to use a mobile device to stay updated and communicate with friends and family living far away. Students had different mobile devices such as smartphones (30%), laptops (47%), and tablets (23%). The older students who did not have mobile devices stated their interest in purchasing one in the next year (48%). With these results, it is possible to see the increased interest of older adults in using the latest digital technologies to be digitally and socially included in the world.

**Keywords**: elderly digital inclusion, mobile devices

## 1. Introduction

Each year the number of older people increases the worldwide. Life expectancy in Brazil in 2015 was 75.2 years, revealing a new picture of the profile of the Brazilian population (IBGE 2015). This is only possible because of different factors that provide a better quality of life. This change in population's profile enables new discussions in different fields such as health, trade, and education. Older people are seeking among other things, continuing education courses, such as digital inclusion.

Digital technologies are increasingly becoming a part of the daily lives of people around the globe. Recently the number of mobile devices, such as smartphones and tablets, sold and purchased by various types of people has grown. A survey conducted by the Getulio Vargas Foundation University (FGV) in São Paulo, pointed out that in 2015 there were 306 million devices connected to the Internet in Brazil, 154 million of which were smartphones (FGV 2015).

Therefore, like younger people, the elderly are increasingly acquiring or receiving mobile devices, especially smartphones, as presents from family members. However, the elderly have many difficulties handling these devices. In addition to their lack of experience using them, these technologies present particular difficulties and barriers for older people such as operating the touch screen, small screen size, etc. These barriers can create frustrations and anxieties in the elderly. Thus, it is necessary to develop actions that include them and provide them the opportunity to use these technologies, as well as promote theoretical discussions on possible strategies that could help the elderly to use these resources.

Many questions arise based on this scenario, especially about the difficulties, needs, and profile of the elderly who use or want to use these technologies in their daily lives. The aim of this paper is to present a mapping of the profile of elderly people who sought, through a digital inclusion course, how to use mobile devices such as smartphones and tablets. Based on this mapping, teaching strategies are proposed that could be adopted for the elderly to learn how to use these mobile devices.

Since 2009, the Center for Digital Technology Applied in Education (NUTED) at UFRGS has offered digital inclusion courses for seniors. In the 2013, they began the "TecMovI - Mobile Technologies for the Elderly" project, which offers courses on how to use mobile devices. The older students learn how to handle digital technologies, including the communication and interaction features they offer.

In order to discuss this issue, the next section presents the concept of mobile devices, as well as studies that have been conducted in this area. Section 3 presents the methodology that was used in this article. The results are presented in Section 4. Finally, Section 5 presents the final conclusions of this research.

## 2. Use of mobiles by the elderly: Discussing concepts

The IBGE (2011) pointed out that the elderly population has increased in Brazil in recent years, due to changes in birth rates, fertility and infant mortality, as well as growing attention regarding quality of life. Thus, the demand for educational activities involving cultural, social, and technological changes increases every year, especially those aimed at the elderly.

This new perspective regarding the elderly population enables further research into their use of digital technologies. There are many studies investigating the use of technologies, both analog and digital, by the older members of the population. Research on digital inclusion of the elderly (Kachar 2010, Carvalho et al. 2014) indicates that their motivation for learning digital tools is associated with communication, primarily to get closer to relatives and friends. However, there has yet to be an in-depth study about their learning about mobile devices.

The term mobile is still discussed a great deal because there is a confusion between concepts that are used synonymously. In this article, mobile devices are directly related to mobility and connectivity. The main examples of these devices are tablets and smartphones. Grande (2016) points out that the term mobile is different from the term mobile technology that addresses "a wider range of resources than mobile devices, as is the case with wireless connections, Bluetooth, 3G or 4G etc." (Grande 2015 p. 29)

Mobile devices are present in people's daily lives because they are technologies that enable communication and interaction, as well as quick access to information. Due to the fact that they have become so commonplace and are a practical way to communicate with the younger generation, older people are increasingly seeking opportunities to learn how to use these technologies.

There are studies related to the use of mobile technology by older people through health-focused applications (Granell Sendra Lloret Rodrigues 2014, Arnhold Quade Kirch 2014). There is also research investigating ergonomic issues related to usability and accessibility.

The term mHealth (mobile health) is used to represent the use of digital technologies in health care through mobile devices (not exclusively for the elderly population). The mHealth applications are based on software and projects aimed at healthcare and education. The virtual environment provided by mHealth provides a variety of projects to improve health systems regarding: (1) Access to information; (2) Real time screening and diagnosis of diseases; (3) The provision of relevant content for the prevention and treatment of diseases; and (4) Online training for employees in healthcare.

Hence, mobile devices are being used to support the care for the elderly through environmental monitoring and diseases such as diabetes etc. (Granell Sendra Lloret Rodrigues 2014 Arnhold Quade Kirch 2014). The study by Yu et al. (2015) shows that the use of an application, combined with social networks, improves adherence to medication. Moreover, Pierleoni et al. (2015) presented an application that monitors elderly falls. Though this application only works when the smartphone is in the user's pocket, it effectively notifies a relative or caregiver of the need to help the older user.

In addition, there are studies on interface design for devices and applications for the older population. Some authors point out that their use of mobile devices, such as smartphones and tablets, is different than other segments of the population. Therefore, it is important to discuss how to make the interfaces of these technologies attractive to the elderly (Yang Huang, 2015, Wu 2015 Santos Ishitani Noble 2013).

Mol (2011) and Página (2014), Díaz-Bossini and Moreno (2014) present some recommendations to improve the usability of interfaces for the elderly, mainly including the limitations of mobile devices (touch screen, large buttons, responsive screen etc. ) and the needs they present. According to Zandbergen (2015), the main problem is their lack of technological knowledge, which directly influences the elderly's lack of persistence in the use of these devices and their applications.

Unfortunately in the field of education, there is little research directed at the teaching and learning process for the elderly. Studies by Yu et al. (2015) and Pierleoni et al. (2015) argue that applications can be great sociability tools, because they offer resources for social interaction and the demonstration of affection for the target audience of this research. Yang and Huang (2015), Wu (2015), and Mol (2011) have investigated usability from the technical standpoint, showing that mobile technologies need to take into account the characteristics that affectively and socially captivate elderly users if they are to increase their identification with these devices and applications.

Hence, there is a need for more research on the pedagogical possibilities of digital and social inclusion of the elderly through the use of mobile devices.

## 3. Methodology

This research was conducted as a qualitative and quantitative case study. A case study format was chosen because it enables research to be conducted using different approaches and resources to collect data, exploring various aspects and points of view.

The target audience of this project was 19 elderly adults, over 60 years of age. The course offered was published in local newspapers and/or through the university's websites. The criteria for participation were:

- 60 years of age or above;
- Literate;
- Have basic computer skills
- Have access to a mobile device such as a smartphone or tablet (with Internet access);
- Have an interest in learning about using mobile devices;
- Signature on the informed consent form.

To meet the ethical issues regarding this research, all participants were informed in the first class about the intended objectives and the methodology that would be used. An informed consent form was given to all of the participants to formalize the research and clarify the topics mentioned above, allowing individuals to choose if they would like to participate. It was also highlighted that the information provided by the students would be private and their identities would be kept confidential. Thus, our study consisted of four stages:

*Step 1: Theoretical framework*

This stage was focused on the construction of the theoretical framework considering studies in the areas of Education, Educational Gerontology, and mobile devices. This step had a cyclical character.

*Step 2 - TecMovI Course: Mapping of the profile of the elderly using mobile devices*

From the benchmarks built in Step 1, it was possible to offer a course on the use of mobile devices for the elderly, particularly tablets that were offered to the students. These tablets were purchased through a project to promote the National Council of Technological and Scientific Development. At this stage it was possible to map the profile of the elderly population, their needs, and difficulties

This course covered tools to use mobile devices, both smartphones and tablets. It was offered through the Digital Inclusion Unit of UFRGS (UNIDI). The class was held once a week for 2 hours, for a total of 2 semesters. Different instruments were used for data collection, including:

- Records of participant observations of the comments and questions of the elderly students during class;

- Short questionnaires were given to the participants before, during, and after the course which included objective and essay questions;

*Step 3 - Analysis of the data collected*

At this stage there was a discussion about the results collected. Quantitative data was analyzed using statistical methods. The analysis of qualitative data was performed through  content analysis, including critical or hidden understanding of communication. The steps suggested by Bardin (2004) were followed to conduct the content analysis.

*Step 4 - Construction of teaching strategies*

This stage focused on the construction of pedagogical strategies for the elderly to use mobile devices, based on the difficulties and needs they identified. At this stage it was possible to explain an array of pedagogical strategies that can serve as the basis for future courses of digital inclusion of the elderly, as shown in the results below.

## 4. Results

The Federal University of Rio Grande do Sul (UFRGS) offered a course for seniors called TecMovI: Mobile Technologies for the Elderly. In this course the older students learned how to handle digital technologies, especially mobile devices such as smartphones and tablets. In 2015, 19 seniors participated in the course with an average age of 67. Only 5 of the participants were males. Interviews were conducted with these students at the beginning of the course and they were asked why they were interested in this course and if they had a mobile device. The largest percentage said they already had a laptop (47%), followed by those who had a smartphone (30%) and tablet (23%). This data shows that this group is already trying to acquire this type of technology and keep up to date. As one of the participants pointed out, "Integration in society, evolution of time, etc." (Senior 14). Tablets and smartphones appear to be attractive to seniors due to their portability (Figure 1). The older students who do not have mobile devices showed interest in purchasing one in the next year (84%) (Figure 2).

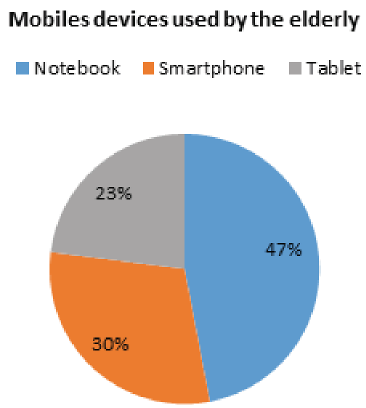


**Figure 1**: Mobiles devices used by the elderly

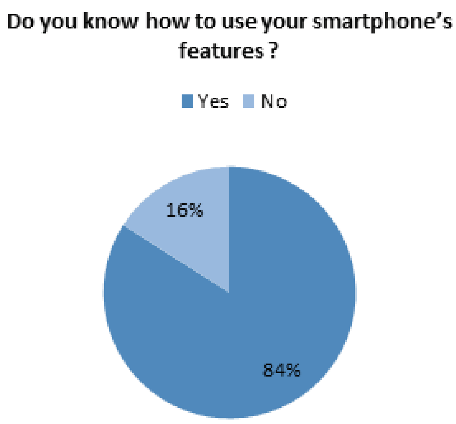


**Figure 2:** Do you know how to use your smartphone's features ?

Half of the elderly participants (50%) stated in the survey that they would like to have a fast and direct way to communicate with their relatives, especially when they travel. This difficulty was remedied after learning about the WhatsApp application, which proved to be an effective tool to meet this need. Students also pointed out that they were interested in the course to learn how to use mobile devices to communicate and interact with their relatives and friends. As one senior stated, “It is quick and easy to communicate with people, learn about what is new, accompany progress, enjoy modernity" (Senior 9)

After the first 6 months of the course, the students stated that their ability to learn about mobile devices was average (53%), followed by remains difficult (27%) and is easy (20%) (Figure 3). This indicates that older people still have difficulty handling technology, but are motivated because they intend to purchase one in the coming year. As one of the seniors said, “It is easy to carry anywhere, has wireless Internet and works like a computer" (Senior 6).

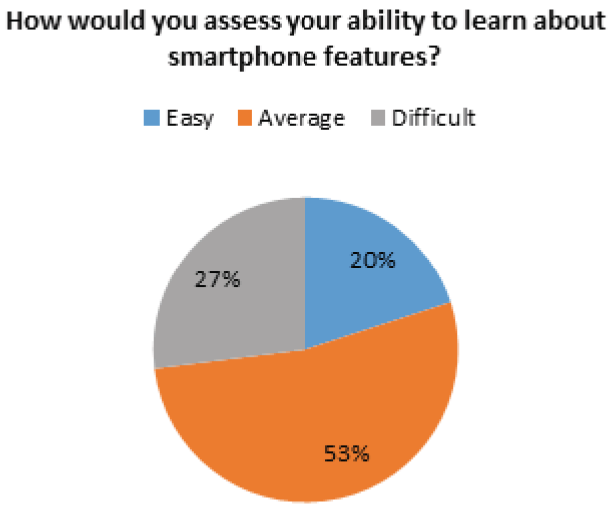


**Figure 3**: How would you assess your ability to learn about smartphone features?

The elderly also constantly asked to learn about social networks, especially those that allow them to directly communicate with video messages and text, such as Facebook. In addition to this request, they wanted to learn how to use some tools to stay current with the news and for entertainment.

The seniors preferred touch screens (78%) to the standard keyboard. This shows that older people have adapted to the model of smartphones and tablets used in the classroom (Figure 4).

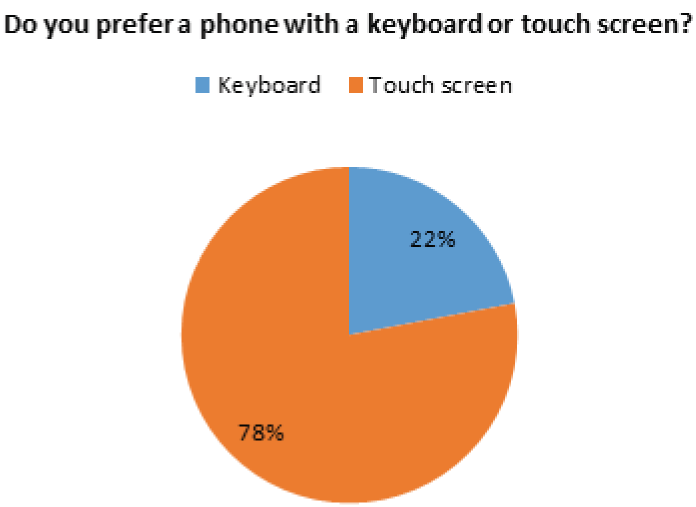


**Figure 4**: Do you prefer a phone with a keyboard or touch screen?

The greatest difficulty that the elderly had in the class was apply the correct finger pressure on the touch screen, because students had to adapt to learn how to work with mobile devices. Another difficulty was using applications (searching for them as well as installing, and removing them).

Based on the elderly's difficulties and needs they articulated regarding use of mobile devices, it was possible to build pedagogical strategies that can be adopted in courses for digital inclusion of the elderly.

These teaching strategies were built from the theoretical framework, as well as the difficulties pointed out by the seniors, according to the data presented above.

Martin (2007) suggests that pedagogical strategies for seniors should be focused on self-confidence, because it stimulates self-assessment. Therefore, strategies should be in accordance with the context of the elderly (Machado 2013), providing for creativity, sociability, affection, curiosity, and personal development. That is, they must be appropriate for achieving the educational objectives.

The experiences of the elderly students in the digital inclusion course learning how to use mobile devices was the basis for constructing these strategies. The course was 2 semester and during this time educational practices were performed and transformed into teaching strategies.

Therefore, the teaching strategies that can be adopted for courses for digital inclusion of the elderly to use of mobile devices are:

- Use concrete materials that can work on learning finger pressure necessary to use the touch screen, such as modeling clay;
- Map types and models of mobile devices that older people have access to so that effective teaching practices can be created;
- Use applications compatible with most mobile devices, for iOS or Android operating systems;
- Use free applications that do not have advertisements that may hinder the elderly;
- Select applications that work on-line and others that after they are installed can work off-line on the mobile device. This simple action can be very useful when there is a bad connection, power outage, or problems to install during the class, for example;
- Show tools and applications for communication, because this is one of the main objectives of the elderly when using mobile devices;
- Create discussion groups where they can have their questions answered about how to use mobile devices at any time;
- Encourage the elderly to interact with their families about learning about these technologies.

The teaching strategies presented in this study were based on the profile of the group of seniors that participated in the TecMoVi class. Other pedagogical strategies may be more efficient in other contexts.

## 5. Final considerations

The elderly will increasingly be using mobile devices. Education, as well as other areas, should be aware of these changes, discussing and developing teaching strategies that can help older people handle these technologies.

Being inserted in society also implies knowing about new technologies, because entertainment, discussions, learning, and communication intensively permeate all stages of life. Despite the integration of digital technologies, such as smartphones and tablets, in their everyday lives, the elderly have difficulty using them. Generally, these difficulties are associated with the need for quick access and motor agility, as well as dealing with the large amount of content and frequent updates required by the devices, according to the research data. Older people have a harder time or are unable to use technological resources because they do not feel confident to use them on their own or are ashamed to ask for help.

The aim of this paper was to map the profile of older people who started learning about these technologies. This mapping enabled the construction of an educational strategy that can be adopted in courses for digital inclusion of the elderly to work with mobile devices. The strategies were built based on technological issues (problems of the elderly) when using mobile devices and the theoretical framework of digital inclusion of the elderly.

Education has not yet begun to reflect more deeply on issues relating to the importance of building pedagogical strategies in the use of mobile devices for the elderly. Therefore, new research on the use of mobile devices for elderly and the contribution of education to this process is extremely important.

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# Electronic Education in Mathematics Teachers Training

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**Abstract**: Electronic education in the field of teaching mathematics means the management of the educational process with the aid of electronic tools. The use of digital technology in the educational process is a significant motivator. The digitisation of educational materials corresponds with the current trend of the Next Generation Learning Challenges (NGLC). The educational process in mathematics is innovated by using computers and mathematics educational software. These modern digital technologies enable the development and strengthening of mathematical knowledge, guide pupils and students to work independently, and teach them self-control. Modern digital technologies also show possible uses of mathematics in other scientific fields to pupils and students. Especially in technical fields, the understanding of graphics programs, such as AutoCAD, is necessary. Geometrical training with the aid of modern digital technologies allows us to demonstrate mathematical proofs, formulate the properties of geometric objects, and construct various geometric objects using digital instruments that replace the conventional method (ruler and scribing compass). Computer geometry uses different tools compared to the traditional geometry. Constructions made with the help of the computer are not only modern and popular but also exact and prompt. Pupils and students appreciate these qualities during lessons as well as in their homework. The computer has thus replaced the conventional drawing on paper. Modern geometry is interactive and dynamic. The geometry program user can influence the situation on the screen and change the parameters of the objects. This paper will focus on the use of computers in teaching geometry. This area is important for the education of future experts and for their technical practice.

**Keywords**: electronic education, teaching mathematics, computers in teaching geometry

## 1. Introduction

The method of dynamic modelling in geometry software in mathematics enables pupils and students to define concepts and discover properties and relations in independent creative work. Pupils and students actively participate in this process of learning, and master concepts on the basis of their own experience. Defining a particular concept and formulating the properties of an object is preceded by graphic depiction. Such a graphic representation gives pupils a specific idea of the studied object.

## 2. Digitisation and spatial imagination

Digital technology is used in various mathematics topics. The method of graphic representation, the construction digitisation, and the animation of the process of construction play key roles in forming spatial imagination in pupils and students. Stereometry is considered one of the most difficult parts of school mathematics. Stereometry in school mathematics covers tasks the purpose of which is to construct the intersection of a plane and a geometric object. The aim of our research was to establish how successful students of the Mathematics Oriented at Education study programme and the Teaching Mathematics at the 2nd Level of Primary School study programme were in constructing a cross-section of a geometric object. (1)

*Task 1.1:* In the ABCDEFGH cube in the figure 1, there are points K, L, M determining the plane of the cross-section. Construct the cube cross-section on the KLM plane.

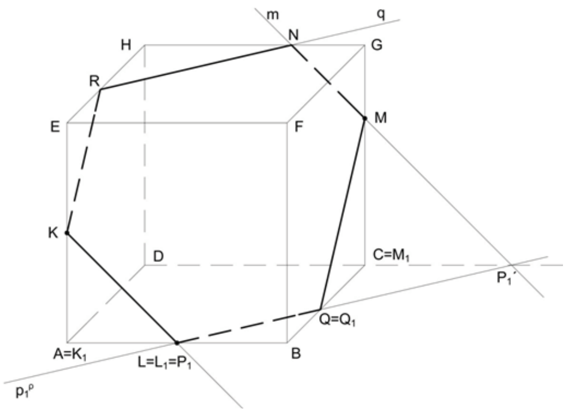


**Figure 1**: Cube cross-section on the KLM plane

In the ABCDEFGH cube in the figure 1, there are points K, L, M determining the plane of the cross-section. Construct the cube cross-section on the KLM plane.

**Table 1:** The success rate statistics as regards Task 1.1

| Study programme | Mathematics Oriented at Education | Teaching Mathematics at the 2nd Level of Primary School |
|---|---|---|
| Successful solutions in % | 56.3 % | 73.7 % |

We also asked the students whether the animation of spatial construction helped them understand the task and whether the digital construction animation developed the ability to imagine objects in space. It was also our aim to establish whether construction animations aided the students in their self-study. [1]

**Table 2**: Animation and spatial imagination

| Study programme | Mathematics Oriented at Education | Teaching Mathematics at the 2nd Level of Primary School |
|---|---|---|
| Construction animations have an effect on the development of spatial imagination (in %) | 86.3 % | 92.7 % |

## 3. Implementation of modern technology in the theory of curves

The dynamic development of information technology is reflected in the concept of teaching at primary as well as secondary schools. Teachers seek new teaching methods and use modern technologies to gain pupils' interest and develop the talent in pupils who like the subject and can develop their knowledge and skills more quickly. [2] The computer may help to explain the respective subject-matter to less academic children in such a way that these children will be able to view the educational presentation again at home. Pupils and students who have difficulties can revise the procedures and methods using such presentations, while talented pupils and students who have their own ideas and want to gain extra knowledge not covered in class can use the computer to further develop their knowledge. The mathematics teacher may motivate his/her pupils to work independently and creatively through a suitable computer software. Lessons using the computer are interesting to pupils and students. Teachers should use this motivator when teaching new topics, when repeatedly explaining something that their pupils and students do not understand, or when expanding the knowledge of their pupils and students beyond the framework of the school curriculum. We can therefore demonstrate areas in which the teacher can use the computer and computer software in lessons. The use of the computer and computer software in lessons constitutes a major aid in:

**Illustrations**

Computer presentations can explain a new concept, property or relation in graphic form. Pupils and students will understand a new concept much better if the theory is supplemented by an illustration, diagram or graph. This way, pupils and students will actually see what is being explained. [3]

**Dynamics**

Dynamic graphics programs allow one to change the object parameters, and guide pupils and students to discover new properties of objects. The concept being explained can be illustrated in many cases. In teaching mathematics, it is important that pupils and students understand the concepts which they are learning.

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Conventional geometry lessons in which pupils use the traditional tools (rulers and scribing compasses) are not only important for developing manual skills but also contribute to the formation of a quality concept system. At present (in the ICT era), the mathematics teacher can also use didactically more effective methods. The quality of the concept-forming process may be influenced by the use of ICT in teaching geometry. ICT includes mathematics programs that have dynamic environments and enable the modelling of various situations. The dynamic process allows pupils and students to observe the properties of mathematical objects. Therefore, dynamic models help pupils and students to better understand mathematical concepts, and such understanding in turn influences the process of memorising. This paper focuses on the use of mathematical modelling in the environment of mathematics programs. The method of dynamic modelling in the geometry software environment in geometry allows pupils to define concepts and discover relations and properties while working independently and creatively. Pupils actively participate in the process of learning and master concepts on the basis of their own experience. Defining a particular concept and formulating the properties of a geometric object is preceded by graphic depiction. Such a graphic representation gives pupils a specific idea of the studied object. Digital technology is used in various mathematics topics. The method of graphic representation, the construction digitisation and the animation of the process of construction play key roles in forming spatial imagination, see for example Figure 1.1 Cube cross-section on the KLM plane. In school geometry, students are also familiarised with the basic plane curves (ellipse, hyperbola and parabola). Graphics programs, such as Geometrie Cabri, Geogebra and AutoCAD, are suitable tools for the construction of curves. [2] Instead of drawing using a ruler and a scribing compass, pupils and students can draw curves in a graphics program. Constructions made in the graphics program environment are neat and easy to take in. The construction digitisation enables quick changes in the objects' parameters. Changing parameters results in the discovery of new properties of geometric objects. Computers may help in the following areas: illustrations, dynamics, lucidity, faster work, adapting the pace to the needs of the pupil, immediate feedback, automated correction of the pupils' answers, and facilitating the preparation of printed materials. [4] The paper also focuses on the role of the computer in mathematics lessons, in particular in geometry lessons. (2) This focus will be based on the research (questionnaire survey) conducted in cooperation with students of the Faculty of Education of Palacký University in Olomouc, Czech Republic. Students at the Department of Mathematics were given a questionnaire, in which we asked whether the students believed that digital constructions helped them understand construction tasks. (1)

**Table 3**: Statistics of understanding digital geometric constructions

| Study programme | Digital construction is illustrative and helps in concept understanding |
|---|---|
| Bachelor's study programme Mathematics Oriented at Education | 79.7 % |
| Master's study programme Teaching Mathematics at the 2nd Level of Primary School | 96.7 % |

Our aim was to determine whether construction animations helped students to develop their spatial imagination.

**Table 4:** Animation and spatial imagination

| Study programme | Construction animations help develop spatial imagination |
|---|---|
| Bachelor's study programme Mathematics Oriented at Education | 74.3 % |
| Master's study programme Teaching Mathematics at the 2nd Level of Primary School | 92.7 % |

Technical practice and geometry are closely connected in the topic of "Technical Curves". It is advisable to use graphics programs in this area. Pupils appreciate especially the quick and exact curve construction. The use of graphics software allows pupils and students to take delight in solved tasks. Positive feelings increase the interest of pupils and students in mathematics and technical subjects in general. [5]

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## 4. Technical curves

### 4.1 Spirals

Spirals or helixes are curves which spire around a solid point (origin of the spiral) in any number of coils.

The Archimedean spiral is a curve followed by point $P$ evenly moving along line $p$ that evenly rotates around its origin $O$.

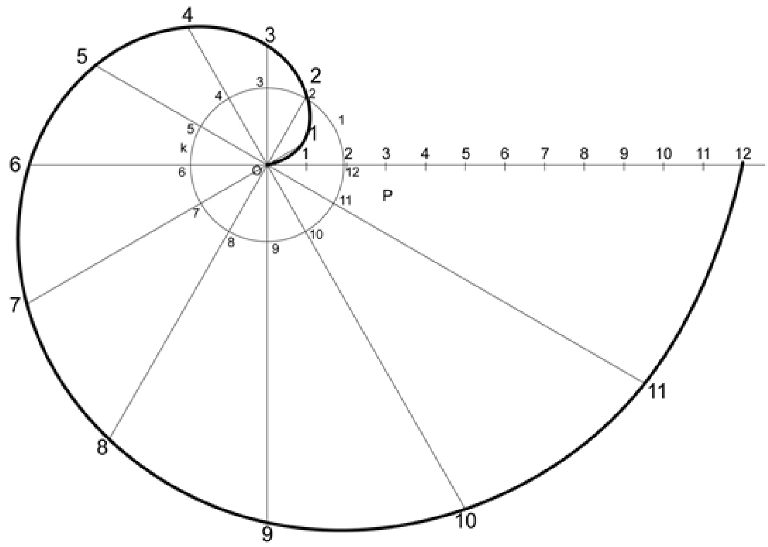


**Figure 2**: Archimedean spiral construction

The construction of the Archimedean spiral can be seen in Fig. 3.1.1. Invariable a is considered the radius of a circle which we divide for example into 12 equal parts; starting at pole O, we draw these parts on the polar axis. Radius vectors 1, 2, 3, … of the spiral are equal to parts 1, 2, 3,… etc. The Archimedean spiral has the following equation in polar coordinates:

$$r = a\varphi \qquad (1)$$

where $a \rangle 0, 0 \le \varphi \le 2\pi$ .

As can be seen in the $r = a\varphi$ equation, radius vector $r$ is directly proportional to amplitude $\varphi$, where $a$ is the proportionality invariable.
For point $P$ (Fig. 3.1.1) $OP = r = a\varphi$ .
A logarithmic spiral is a curve which has the following equation in polar coordinates:

$$r = ae^{n\varphi} \qquad (2)$$

Numbers $a, n$ are any invariables, $a \rangle 0$, $e$ is the basis of natural logarithms, $r$ is the radius vector of point $P = [r;\varphi]$, and $\varphi$ is a polar angle (measured in radian measure).
Upon taking the logarithm of equation (2), we get the following result:

$$\ln r = n\varphi + \ln a$$

The natural logarithm of radius vector $r$ is directly proportional to polar angle $\varphi$, which is why this curve is known as a **logarithmic spiral**.

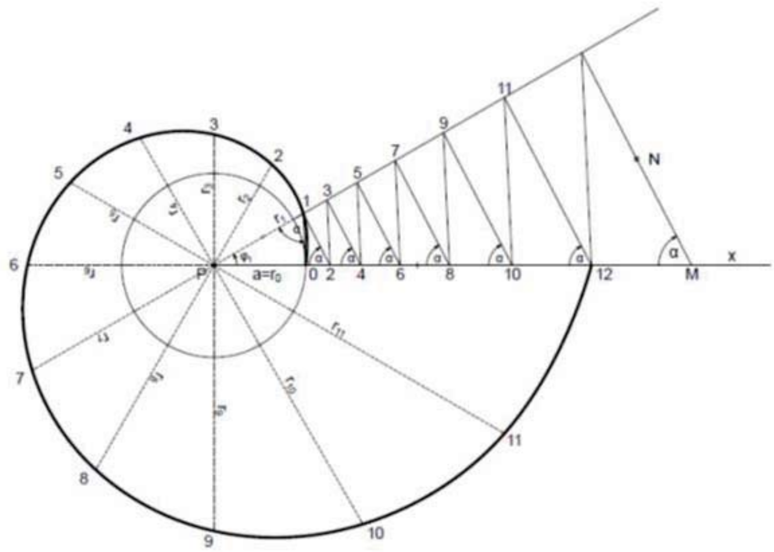


**Figure 3:** Logarithmic spiral

If we divide error $2\pi$ into 12 equal parts (Figure 3.1.2), then $\varphi_1 = \frac{2\pi}{12} = \frac{\pi}{6}$ .

Radius vectors $r_1, r_2, r_3, \ldots, r_{12}$ have errors $\varphi_1, 2\varphi_1, 3\varphi_1, \ldots, 12\varphi_1$ and form an arithmetic progression.

For $\varphi_0 = 0$ , $\varphi_1, 2\varphi_1, 3\varphi_1, \ldots, 12\varphi_1$

$r = a$, $ae^{n\varphi_1}, ae^{2n\varphi_1}, ae^{3n\varphi_1}, \ldots$, and these are radius vectors $r_0, r_1, r_2, \ldots$ (Figure 3.1.2)

$\frac{r_1}{r_0} = \frac{ae^{n\varphi_1}}{a} = e^{n\varphi_1}$ ; $\frac{r_2}{r_1} = \frac{ae2^{n\varphi_1}}{ae^{n\varphi_1}} = e^{n\varphi_1}$ ; $\frac{r_3}{r_2} = e^{n\varphi_1}$ etc.

As the proportion of the following radius vector to the previous one is constant and equal to $e^{n\varphi_1}$ , radius vectors $r_0, r_1, r_2, r_3, \ldots$ form a geometric progression.

Provided that we know the lengths of radius vectors $r_0, r_1,$ for $\varphi_0 = 0$ , $\varphi_1$, we can construct other radius vectors $r_2, r_3, \ldots$ on the basis of the similarity of triangles.

We transfer angle $\alpha$ to any point $M$ on the polar axis. Line segment 12 is parallel with $MN$ .

Triangle $PO1$ is similar to triangle $P12$ , therefore:

$$\frac{r_1}{r_0} = \frac{P2}{r_1}$$

If $\frac{r_1}{r_0} = \frac{r_2}{r_1}$ , then $r_2 = P2$

Line segment $23$ is parallel with line segment $01$ ; the following ensues from the similarity of triangles $P12$ , $P23$ :

$\frac{P2}{r_1} = \frac{P3}{P2}$ ; also $\frac{r_2}{r_1} = \frac{P3}{r_2}$ and if

$\frac{r_2}{r_1} = \frac{r_3}{r_2}$ , then $r_3 = P3$

In this way we can construct other radius vectors $r_4 = P4$, $r_5 = P5$ etc.

Radius vectors thus constructed are applied on the half-lines that pass through pole $P$ and divide angle $2\pi$ into 12 equal parts; we connect end points 0, 1, 2, 3, …, thereby getting a logarithmic spiral.

In technical practice, the principle of logarithmic spiral is used by adjustable disk condensers and snips, among other things.

If a condenser is to have an even scale, the condenser plates must be shaped as logarithmic spirals. In the case of snips, the angle of shearing (and thus the necessary force) will be constant if one blade is straight (a line) and the other is shaped as a logarithmic spiral.

## 4.2 Spirals in nature

The shape of the spiral, which we can observe in unicellular foraminifera, sunflowers and the falcon's flight, can also be seen in star systems, for instance in the Milky Way galaxy. Observations have revealed that there are about one hundred billion galaxies in the observable outer space, many of which are spiral galaxies. Spiral galaxies are characterised by spherical centres from which the individual arms stretch out. Such a galaxy is shaped as a flat disk, has a distinctive spiral structure, and is made up of logarithmic-spiral arms. Our galaxy, the Milky Way, has four arms shaped as spirals with the tangential angle of approximately 12°. [6]

**Figure 4**: Milky Way

Tropical cyclones and hurricanes also resemble logarithmic spirals. Similar spirals are created by low-pressure air currents – north of the equator, they rotate clockwise, while on the Southern Hemisphere they rotate the other way round. The logarithmic spiral, just like the hyperbola, is seldom found in man-made creations. Nevertheless, the spiral shape of, for instance, a winding staircase does put one in mind of a logarithmic spiral when viewed along the axis. An example of this layout can be the view from the top of the double-intertwined winding staircase at the Vatican Museum, built according to a sketch by Leonardo da Vinci.

**Figure 5:** Winding staircase at the Vatican Museum

The logarithmic spiral appears as early as the Ionic order, which was one of the architectural styles of Ancient Greece (capitals and Ionic Columns). The most famous buildings in this style include the Erechtheion, the Temple

[6] Janík, T., stuchlíková, I. *Oborové didaktiky na vzestupu: přehled aktuálních vývojových tendencí*. Scientia in educatione 19 1(1), 2010, pp. 5–32.

of Athena Nike on the Acropolis of Athens, and the Temple of Artemis in Ephesus, which is one of the Seven Wonders of the Ancient World.

**Figure 6**: Ionic capital

## 5. Conclusion

In conclusion, we can say that the dynamic modelling method in the graphics software environment allows students to discover connections between objects in pictures. It also develops spatial imagination, which is essential in technical study programmes. Students are then able to solve tasks that require spatial imagination. Working with digital tools is a creative activity that supports creativity and develops thinking as well as the spatial understanding of the given issues. Gaining knowledge on the basis of one's own experience is important in the process of memorising and learning.

Today, technical drawing is a major tool in various scientific, technical and production fields, such as mechanical engineering, electrical engineering, civil engineering, land-surveying etc. The importance of technical drawing keeps increasing along with technological progress. The subject of basic technical drawing should be introduced in general schools as a significant part of the system of polytechnic classes. This would increase the quality of education, and the graduates would be better prepared for practical life as well as for further studies at technical schools.

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# An Online Language Learning Program for Students in Aviation Departments

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**Abstract:** This study is the first phase of a project that aims to improve the technical English level of students who study in 10 vocational schools in 10 different cities providing training and education on aircraft maintenance. The actual English level of these students is not enough to achieve Aircraft Maintenance License and become a certified staff since syllabus of these vocational schools do not include technical and general English. Therefore, students must self-study to develop a good level of both general and technical English. The first phase of the study aims to offer online English language training for the students of vocational high schools. This training was created as a separate course and students were asked to study on their own with their course books and a Learning Management System. A course book that has an online LMS was chosen and provided for the students who attended 10th grade. Before the training, the students were given a placement test and their levels were found to be A2 according to Common European Framework of Reference for Languages (CEFR). The students were informed about the course, the enrolment process and the syllabus. LMS system did not include the same units with the course books so a detailed syllabus that matched online activities and the units in the book was prepared. An English instructor became the admin in the system and followed their progress and gave students some assignments and quizzes every week. The study lasted for 8 months and at the end of the course, students were given a proficiency test to check if online studies contributed to their English. The students were also given a questionnaire on their perceptions of the online study.

**Keywords**: online language learning, learning management systems, technical English, aviation, technical English

## 1. Introduction

There has been a growth in the global aviation market. As a consequence, aircraft operators in Turkey are to increase the number of aircraft that they operate. The demand for qualified and certified aircraft maintenance staff has increased as well. The graduates of vocational schools providing training and education on aircraft maintenance are potential human resources for the MRO (Aircraft Maintenance, Repair, Overhaul) market. Since these schools are not approved by EASA or by the National Aviation Authority, the graduates must take some examinations to obtain an Aircraft Maintenance License and become a certified staff (Ref. European Aviation Safety Agency-EASA Implementing Rule Part 66, Paragraph 66.A.25 Basic knowledge requirements). Moreover, paragraph 66.A.20 Privileges states that “The holder of an aircraft maintenance license holder may not exercise its privileges unless he/she is able to read, write and communicate to an understandable level in the language(s) in which the technical documentation and procedures necessary to support the issue of certificate or release to service are written”.

These requirements create some problems for the graduates of the schools stated above. Because the syllabus (technical and language) of these schools is not compatible to EASA Part 66 requirements, this means that the graduates must self-study for the examinations. In Turkey, lack of self-study materials prepared in the Turkish language mandates these students to have a good level of both general and technical English. Recent studies showed that the actual English level of these students is not enough to take some technical English courses. Therefore, a general English course is integrated to the Technical English Course. National and International Aviation Regulations require technicians to have a knowledge base in English in order to read the documents. It is known that misunderstanding or not understanding technical documents can cause even plane crashes (Tajima, 2004: p. 451). Thus, staff working in aviation should have a good command of English.

## 2. Literature review

### 2.1 Online language learning

Internet technologies have inevitably become part of professional, academic, individual and commercial life. In particular, the use of Internet technologies in education has spread in recent years. Through the emergence of Internet technologies, face-to-face education has been supported with online learning and traditional methods have been transferred to online platforms. Online technologies in foreign/second language learning affects learning positively enabling students to encounter authentic visual and interactive materials and to listen to native speakers. "Students believe that using interactive technologies helps them to increase learning productivity, encourage a deeper approach to learning, promote the development of communication skills, and improve their understanding of course content" (Kember et.al, 2010). As Mayer (2011) states, the combination of verbal and visual information presented in multimedia environments is not only appealing for learners, but also facilitates the processing of large amounts of information by addressing multi-sensory modes. Students can interact with their peers and teachers as well as other language learners throughout the world. Thus, their learning becomes more permanent and entertaining, and they become more autonomous, having control over their learning process. Supporting student-centered learning, these environments also help teachers to evaluate their students instantly and to give feedback (Aydin, 2014).

Language learning has also been affected by recent technological developments, and teaching has extended over the boundaries of classroom teaching. As Seljan, Banek Zorica, Spiranec and Lasic-Lazic (2006) state, using new technologies in language teaching has infinite potential, and language learning necessitates the use of new technologies more than any other social science discipline (Kartal, 2005). As Lai et.al (2016) state enhancing self-directed use of technology for language learning is essential for maximizing the potential of technology for language learning.

"Learner participation and interaction is important in successful language learning, whether it is face-to-face, blended, or fully online, and it is believed that greater participation in course communication results in students experiencing greater cognitive and explanatory learning" (Sun, 2014: p.21; Paskey, 2001). Computer Mediated Communication (CMC) has been put forward as a powerful environment for collaborative learning across the globe by Grooms (2003) and is applied by the teachers both synchronous (teachers and students communicating at the same time) and asynchronous (different students dealing with the same content at different times) modes. Learners of today are observed to manage, evaluate their own learning and provide self-feedback so they have a high level of communication (McLoughlin & Lee, 2010).

According to Fee (2009), students are more computer literate than their teachers nowadays, with many preferring to access information using the Internet. Thus, the aim of education in this digital age is to provide students the opportunity to reach information quickly and accurately and to help them to analyze and evaluate information in a right way by using online tools.

Online platforms that include many exercises, as well as voice or video chat, enable students to use the target language in a written or oral manner in different environments so that structures are recorded in their long-term memory and become automatic. Hence, the learners become more fluent in speaking and writing (Altunay, 2011).

Sagarra & Zapata (2008) examined student perceptions regarding the learning of a foreign language in an instructional environment that combined face-to-face meetings with weekly online homework. The results of the survey on student perceptions indicated that most students had easy access to the online environment and workbook and acknowledged a mutual relationship between class content and online materials, stating that the electronic workbook helped them learn the target language. Students in their study were found to acknowledge a mutual relationship between class content and online materials. They liked having multiple attempts, receiving immediate feedback, working at their own pace, and having access to the correct answers after submitting their work, as well as enjoying activities that use a myriad of formats, which are accompanied by images, and that allow them to work within the online learning environment (Sagarra & Zapata, 2008:219).

## 2.2 Role of English in aviation

As Parohinog & Meesri (2015) state aviation remains the most dynamic industry worldwide and it facilitates global trade and tourism as well. As the demand for airlines increases, the demand for qualified and certified aircraft maintenance staff has increased as well. People who work in the aviation industry should have a good command of English in order to communicate with other staff and read the documents. Barshi and Farris (2013) point out that communication breakdown is not caused by speech rate or poor English language proficiency, but by lengthy messages. Despite the claims, the International Civil Aviation Organisation (ICAO) insists that in previous accidents, it was found that the common contributing element was insufficient English language proficiency on the part of flight crew or controllers (ICAO Manual, 2010, 1.2.1).

To address these dilemmas, ICAO identified six areas of language competency in which aviation personnel must be proficient including the following: pronunciation, structure, vocabulary, fluency, comprehension, and interactions (ICAO Manual, 2004, 2.8.1; cited in Parohinog & Meesri, 2015). Carrying out a study on needs analysis of 621 university students from six universities that offer aviation programs in Thailand, Parohinog & Meesri (2015) concluded that the participants suggested a set of online tools that might help them improve their skills on ICAO Language Proficiency Requirements areas. These online tools can be categorized as synchronous and asynchronous. Online tools such as audio-video conferencing, instant messaging, streaming audio and video, and narrated slideshows among others emerged as helpful for the participants.

According to Farris et.al (2008) the communicative environment of pilots and air-traffic controllers (hereafter, controllers) provides an excellent example of challenges in the workplace. Some of the challenges specific to controller–pilot communications include L2 usage, high workload, and the inherent complexity of radiotelephonic communications (e.g., invisible and unfamiliar interlocutor, congestion due to high traffic, radiotelephonic frequency constraints). Controller–pilot miscommunications, particularly those related to L2 use in non-routine, stressful, high-workload situations, can threaten air safety.

High-profile accidents in which hundreds of people lost their lives and in which miscommunications played a significant role have heightened awareness of the importance of L2 proficiency for controllers and pilots. Based on data from several accident-reporting databases, the ICAO has identified controllers' and pilots' inadequate L2 proficiency as a major challenge to effective controller–pilot communications (ICAO, 2004, p. 1-1). In recognition of this challenge, ICAO has introduced language proficiency requirements to ensure that all controllers and pilots are proficient in the language(s) used in air–ground communications. In the international aviation context this language is often English, an L2 for many of the world's controllers and pilots (Farris et.al, 2008).

The ICAO language proficiency requirements, to be applied to all languages used in radiotelephony, stipulate that English be made available in situations where the flight crew and the ground do not share the same language. Therefore, all pilots and controllers involved in flight operations where the use of English may be necessary are required to demonstrate an operational level of proficiency in English, as defined in the ICAO Language Proficiency Rating Scale (ICAO, 2004, A8–A9). As of March 2011, all ICAO contracting states had to comply with these new standards so the aviation community was faced with the task of training and testing thousands of pilots, controllers, and other personnel. One of the first steps in accomplishing this task involved understanding the controller–pilot communicative environment.

In the light of the above findings, this study aimed to explore the perceptions of students studying Aircraft Maintenance in Vocational High Schools through online language learning, to detect the difficulties they met and their views on the content of an online language course.

This study tries to answer the following research questions:

- What are high school students' attitudes on online content?
- What are high school students' attitudes on online learning strategies and styles?
- What are students' preferences for different learning environments?
- What were the challenges and difficulties they met during online language learning?

## 3. Methodology

The participants of the study were 360 students from 10 vocational high schools that provide training and education on aircraft maintenance in different cities of Turkey. The students were in Grade 10. They were offered English language training and this training was thought to be a separate course. Students were required to study on their own with their course books and Learning Management System. A course book that has an online LMS was chosen and provided for the students who attended 10$^{th}$ grade. Before the training, the students were given a placement test and their levels were found to be A2 according to CEFR. For each school, an e-mail group was created and communication was done through e-mails. The students were informed about the course, the enrolment process and the syllabus. The LMS system did not include the same units with the course books so a detailed syllabus that matched online activities and the units in the book was prepared. An English instructor became the admin in the system and followed their progress and gave students some assignments and quizzes every week. For every school, an online class was created in order to follow students' progress and to record their scores. Their frequency of the use of LMS system was also detected.

The research instrument in this study is a survey that utilized both qualitative and quantitative methods for data collection. The questionnaire was based on items drawn from student surveys of the Cook, Owston, and Garrison (2004) COHERE study (Owston et.al, 2013) and Sun (2014). The questionnaire was translated into Turkish in order to avoid comprehension problems. Because of time constraints, the questionnaire was applied in only one school with 165 students.

There were two parts in the questionnaire. In the first part, there were ten questions asking students to indicate to what extent they agreed or disagreed in a five-point Likert scale (1=strongly disagree; 5=strongly agree) on the content of an online course (items 1-6) and learning strategies and styles (items 7-10). In the second part, there were three multiple-choice questions on students' preferences of different learning environments. The results were analyzed using SPSS by calculating means and standard deviations. In the third part, there were 3 open-ended questions asking students about their personal experiences in online learning. Emerging categories were found and categorized. Reliability analyses were also conducted. The inter-rater reliability was found to be .85.

## 4. Results

In terms of students' scores, every class was checked and the number of students who actively entered the LMS and their percentages were found. The schools were named as A, B, C, D, E, F, G, H, I and J.

**Table 1:** Distribution of students according to schools

| School Name | Total number of students in LMS | The number of active students and their percentages |
|---|---|---|
| A | 96 | 35 (9%-52%) |
| B | 15 | 6 (2%-5%) |
| C | 45 | 23 (20%-25%)) |
| D | 68 | 20 (10%-19%) |
| E | 25 | 10 (9%-11) |
| F | 23 | 12 (5%-8%) |
| G | 5 | 1 (2%) |
| H | 34 | 20 (11%-14%)) |
| I | 17 | 9 (8%-10%)) |
| J | 32 | 16 (13%-99%) |
| TOTAL | 360 | 152 |

At the beginning of the questionnaire, there were questions related to students' ages and gender. A total of 165 students responded to the questions. Of these 165 students, 128 were male and 37 were female. Their ages ranged from 16 to 17.

In order to answer the first research question, statements 1-6 in the first part of the questionnaire were taken into account. The students were asked to write how much they agree with the statements. The statements were related to students' opinions on task-based instruction, authentic teaching material, learner initiatives in designing online resources, learner creativity and the role of instructional materials in developing their real life critical thinking skills.

**Table 2**: Student perceptions of online content design

| **Question/Statement** | **N** | **Mean** | **SD** |
|---|---|---|---|
| (1) Online language learning instruction should be task-based rather than rote learning | 165 | 4.09 | 0.70137 |
| (2) Online language learning material should help develop real-life critical thinking skills. | 165 | 3.87 | 0.69413 |
| (3) Authentic learning materials should sometimes be used. | 165 | 3.61 | 0.74471 |
| (4) Learner initiatives should be encouraged. | 165 | 3.59 | 0.85832 |
| (5) Learners should be encouraged to co-construct class resources. | 165 | 3.7 | 0.79474 |
| (6) Learner creativity should be encouraged. | 165 | 3.87 | 0.69413 |

As Table 2 reveals, all student responses were above 3 and the highest being 4.09. It is seen that students think a lot about content design. Since the students of this study were high school students, they were not asked any open-ended questions on content design.

In order to answer the second research question, statements 7-10 in the first part of the questionnaire were taken into account. Students were seen to have practiced self-regulated learning and have been aware of its importance. Their preferences, needs and technology choices were met by online learning. Thus, they learn in their own preferred ways and they have control over their learning.

**Table 3:** Students' experiences of learning strategies and styles

| Question/Statement | N | Mean | SD |
|---|---|---|---|
| (7) I found online learning to be more self-directed and self-regulated. | 165 | 4.09 | 0.92969 |
| (8) Online learning is individualized or personalized learning. | 165 | 3.93 | 0.80006 |
| (9) My preferences, needs, technology choices, etc. were better served by online learning. | 165 | 3.61 | 0.74471 |
| (10) I felt that I had control over the learning process. | 165 | 3.59 | 0.85832 |

In an answer to the third research question, students were asked multiple-choice questions regarding face-to-face, online and blended learning. The responses of students can be seen in Table 4. The responses of the students indicate that 53% prefer a blended course format (n=88), 15% prefer a face-to-face format (n=25) and 32% prefer an entirely online course format (n=52). When students were asked about attending courses, 55% of the students' preferences were again for a blended course format (n=91), 13% preferred face-to-face courses (n=22) and 32% preferred accessing videos of lessons (n=52). In terms of participating in discussions, 29% of the students preferred participating in face-to-face discussions (n=48), 50% preferred a combination of face-to-face and online discussions (n=82) and 21% preferred participating in online discussions (n=35).

**Table 4:** Student preferences of different learning environments

| Course format preferences | Number | Percentage % |
|---|---|---|
| **If the same course is offered in different formats, which course format would you prefer?** | | |
| A. Entirely face-to-face course format | 25 | 15% |
| B. Blended course format | 88 | 53% |
| C. Entirely online course format | 52 | 32% |
| **If you had a choice between attending courses face-to-face or accessing lessons online, which would you choose?** | | |
| A. Attending lessons face-to-face | 22 | 13% |
| B. Accessing online downloadable videos of lessons | 52 | 32% |
| C. A combination of both | 91 | 55% |
| **If you had a choice between participation in classroom discussion or online discussion, which would you choose?** | | |
| A. Class discussion | 48 | 29% |
| B. Online discussion | 35 | 21% |
| C. A combination of both | 82 | 50% |

In order to answer the fourth research question, the responses of the students to question 11 "most challenging thing" in fully online learning were detected as the following:

- lack of interaction and practice with peers (mentioned by 10 respondents);
- having less communication with the teacher (10);
- time management (8);
- isolation (felt lonely) (7);
- limited socialization (6);
- communicating on a computer (6);

- keeping up with things and studying consistently (5);
- no immediate feedback (3);
- self-study (3).

Question 12 was about potential difficulties. There were a list of items and students were asked to tick as many items as were applicable to them.

- Following the schedule and study regularly (40%)
- Technical difficulties, e.g., getting online, access to Internet (33%)
- Keeping the assessment deadlines (27%)
- Keeping in touch with the teacher (24%)
- Keeping interested in the course ( 12%)
- Keeping motivated (6%)

Question 13 aimed to detect what was successful and what was not in students' new effort/methods. Some of the students (20%) stated the importance of self-motivation. Some others (10%) stated that they had difficulty in self-directed learning since they are not used to being responsible for their own learning. They also had difficulty in following a schedule and studying regularly. Some students (24%) stated that they needed training in how to use the LMS as they have not used such a system before. Thus, they could not make use of the activities a lot and their frequencies and scores are low.

## 5. Discussion

The responses for the first research question revealed that students in this study were positive about using an online system to learn English. They liked the idea of task-based materials in which they focus on form and meaning rather than rote learning that is based on repetition and memorization. When they first learnt English, they stated that they mostly used repetition, instead they like to engage in tasks more because they used their critical thinking skills. They stated that they have never thought of learning English online. In terms of the second research question, students were seen to have practiced self-regulated learning and have been aware of its importance. Their preferences, needs and technology choices were met by online learning. Thus, they learn in their own preferred ways and they have control over their learning. Flexibility of online learning attracted their attention since they stated that they could study or do activities wherever or whenever they went. They were their own bosses; they decided their study time and they did not feel the pressure of the teacher. The third research question was about students' preferences. As the results indicate most of the students preferred blended learning when it comes to attending lessons. This result may be due to communicating with teachers. They may have preferred face-to-face contact in order to establish positive interpersonal relations with teachers to build knowledge and to ask questions. In the Turkish educational system teachers are still seen as the sources of knowledge and students always want the approval of teachers. Although they liked to keep track of their own studies in online learning, they may have wanted to receive feedback from teachers on their progress. In terms of attendance, most of the students preferred a blended learning environment, since they may have liked the flexibility of online learning.

The results showed that most students favored a blended course format, in other words, they preferred to attend both face-to-face and online courses. In terms of participation in classroom discussion or online discussion, they mostly preferred blended learning. The percentage of students who preferred face-to-face learning was also high. This may be due to their perception of the role of the teacher in a language class. Students may see the teacher as a facilitator of the acquisition of knowledge and they are used to seeing the teacher as the authority in class. Conducting a study on student preferences of online or face-to-face learning, Paechter & Maier (2010) found that students in their study preferred a choice of communication modes, including face-to-face communication for interaction with a tutor. They also appreciated the rapid exchange of information by means of online communication, e.g., the possibility of obtaining immediate feedback regarding assignments. The findings of this study also support Paechter & Maier's (2010) findings. Students in our study favored face-to-face communication in order to establish positive interpersonal relations with teachers, possibly believing this enhances their learning.

In terms of challenges or difficulties, the majority of students complained about not interacting with their peers, land limited socialization. This is consistent with Muilenburg and Berge's (2005) finding when they surveyed 1056 online learners and reported that "a lack of social interaction was the severe barrier as perceived by students overall" (p. 45, cited in Sun, 2014). Low participation in online activities has been frequently reported in the research literature (Comas-Quinn et al., 2012;). Other difficulties and challenges were less communication with the teacher and keeping in touch with the teacher. These ideas may stem from student beliefs and attitudes towards language learning, since they have traditionally studied languages in a formal classroom setting where the teacher was the only authority. Online language learning is a recent phenomenon and students may have only encountered it at university and had difficulty getting used to student-centered learning, since learner autonomy is a foreign concept in the Turkish education system. Nissen & Tea's (2012) study reveals similar ideas. Conducting a study with seven language teachers on how second generation tutors within blended learning courses link face-to-face and online course modalities, Nissen & Tea (2012) found that most tutors insist on limited student involvement in the online parts of their blended learning courses. There may be a number of reasons for this, such as too few credits being allocated to the course, and proportionally too much personal work required. The findings of this study support this finding. Although the aim of the project was to provide online language education to 800 high-school students studying in Aircraft Maintenance departments, only 360 of them enrolled to the LMS and of 360 students, only 156 of them did the activities and studies in the LMS. The last open-ended question was on what was successful and what was not. In response to the question, students stated that they had difficulty in self-directed learning as they have never tried to study on their own without the presence of teacher. The majority of students stated that they needed training on how to use LMS since they are not used to learning English online and take the responsibility of their own learning. This finding is in line with Barrette (2001) who found that technical training sessions prior to computer assisted language learning (CALL) activities not only enhanced students' computer literacy but also helped them to feel more confident with the CALL activities and to enjoy such activities more.

## 6. Conclusion

As stated before, the first phase of the project aimed to provide online English language training for high school students in Aircraft Maintenance departments and to prepare them for online technical English lessons. The results indicated that students could not make effective use of online learning because they were not prepared enough. Results also showed that students needed training on how to use LMS. Although they were informed by e-mails and given instructions, there appeared a need for a workshop or training. Only one school could be visited by the instructor and given a workshop on how to use the LMS. It was observed that after the training, the students' frequency of use increased. This is one of the limitations of the study since there were 10 different schools in 10 different cities, every school should have been visited and students should be given training on how to use the system. Checking the exam marks of frequent users could have been done. Interviews may have been carried out with the teachers and students as well. Both could have offered further insights on students' progress before and after the online learning program.

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# Inquiry Based and Blended Learning Using Geographical Information System

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**Abstract**: The methods of geospatial data processing are being continually innovated, and universities that are focused on educating experts in Environmental Science should reflect this reality with an elaborate and purpose-built modernization of the education process, education content, as well as learning conditions. Geographic Information Systems (GIS) have the dominant role in geospatial data processing. Students of the Environmental Science study program are learning GIS analysis in order to manage conflicts of interest within the country, and to assess the impact of human activity on the environment. The contribution is focused on teaching GIS, based on real geospatial data and methods, which is implemented through integrated learning. In an effort to get closer to the approach used for real problematic task solving, it is essential to include several interconnected systems in the blended learning. Firstly, the Learning Management System, which is important for the realization of distance education. Secondly, the desktop GIS, which is used by students for creation, capturing, editing, analysing and visualization of spatial data for real problematic task solving. Thirdly, the Global Positioning System, which enables the capturing of data directly from the landscape. The placement of observed objects and phenomena allows students to realize their own mapping of elements and components of the landscape, and to update and verify the existing map layers. The last system employed is the GIS Server that allows students to share and publish the results of related topics of their work, and also helps students to develop their skills in group work cooperation. Students work with professional tools and real data, and the education process has an interdisciplinary approach which develops a wide range of knowledge and acquired skills. The real problem tasks, which are solved during the education process, are student-driven to a significant degree. The role of the teacher as a classroom manager is specific. A similar approach in education can also be used in other branches of the science.

**Keywords**: inquiry based learning, GIS, GPS, LMS, blended learning

## 1. Introduction

Methods of acquisition, processing and visualization of data are constantly being streamlined and updated. Every university must keep up with these developments by maintaining an innovative approach to the content and form of their educational offerings. Adapting to the needs of professional practice can be challenging. Science graduates are also expected to have a level of skills in information and communications technology (ICT).ICT is an umbrella term that includes any communication device or application including radio, television, cellular phones, computer and network hardware and software, satellite systems etc, as well as the various services and applications associated with them, such as video-conferencing and distance learning (Rouse, 2005). Correct usage of ICT in education can improve the quality of teaching and learning, and management in schools, build knowledge across all areas of the curriculum and help to build higher-order cognitive and life skills (Livingstone, 2012; Gaible et al., 2011).

Generally, three objectives are identified for the use of ICT in education: the use of ICT as an object, usually within a specific course, the use of ICT as an aspect, of industry and profession; and the use of ICT as a medium for teaching and learning (Plomp et al., 1996; Drent and Meelissen, 2008).

We apply the above-mentioned three objectives for the use of ICT in the course: Spatial landscape analysis and Advanced *Geographic Information System (GIS)* analysis in the first year of our master's degree within the study program Environmental Science (ES) at the Faculty of Natural Sciences, Constantine the Philosopher University in Nitra. Students use several systems (Figure 1) to gain knowledge in the field of spatial analysis of landscape. Practical use of the systems develop ICT skills and students learn about the individual systems, so they are able to use them in professional practice in the future.

ES is an interdisciplinary academic field, which influences the study and practical training of students in the ES study program. In practice, graduates of the study program are expected to manage conflicts of interest in the country and assess the impact of human activity on individual environmental components. Both of these tasks require data analysis and synthesis from various scientific fields. We have to adapt the content and method of our teaching to equip our graduates with the necessary skills to solve these problems. They need to know all relevant input factors and phenomena, acquire and process them efficiently, overlap them logically, subject them to spatial analysis and synthesis and evaluate and interpret the results accurately.

## 2. Model of GIS education

Use of several close-knitted systems, the main one being GIS, provides a comprehensive solution to this problem. GIS is a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth (Dueker and Kjerne, 1989). Geographic information systems are applied in land-use, planning, ecosystems modelling, landscape planning and assessment, transportation and infrastructure modelling, market analysis, visual impact analysis, watershed analysis, facility management, real estate analysis, and many other areas. The use of GIS tools has also become standard in scientific activities and it is an essential part of research methodologies for the study of phenomena that can be localized in space.

In our experience, the content of GIS teaching is focused on three main interrelated steps: data collection, data manipulation and data dissemination. Within the curriculum each step is subdivided. Links on the left and right side of diagram in Figure 1 refer to various systems within the education process. These are used to increase efficiency in work with GIS, as well as to increase efficiency within the educational process in the Spatial landscape analysis and Advanced GIS analysis courses:

- **Global Positioning System (GPS) -** is an earth-orbiting satellite-based navigation system providing users worldwide with twenty-four hour access to precise positioning in three dimensions (latitude, longitude, elevation) and precise time traceable to global time standards (Dana, 1997). In our work with GPS (Figure 1) we use this for terrain mapping (data collection) and terrain navigation to finalize spatial data (data dissemination). There is close cooperation between GPS and GIS. GPS data are processed during data manipulation steps using GIS tools.
- **Learning Management System (LMS) -** is a framework which controls all aspects of the learning process (Forouzesh and Darvish, 2012). In our case, LMS represents a valuable information source for students as well as an instrument for communication between teacher and students and among the students themselves during work on student projects. LMS is used by students to enhance their skills and knowledge about systems (Desktop and Web GIS, GPS) and individual steps mentioned in our diagram (Figure 1).
- **GIS server** - provides the platform for GIS resource-sharing (maps, geodatabases, etc) and provides access to the GIS functionality that the resource contains. Geoserver is a software server that meets our requirement to view and edit geospatial data. It is an open source server for sharing geospatial data, which provides a number of OGC compliant implementations of open standards such as Web Feature Service (WFS) and Web Map Service (WMS).
- **Cloud storage** - a form of cloud computing, provides an important service (Han et al., 2016). It enables students to easily share their data with schoolmates by uploading their private data into the cloud storage. This system relies on the cloud servers to provide data access control.

All of the software listed above (except Cloud storage) belongs to the open source software group - software that is made freely available to all (Hippel and Krogh, 2003), so programmers or users can read, modify and redistribute the source code of a piece of software (Gacek and Arief, 2004). The above-mentioned storage service that we use is free of charge and data can easily be transferred elsewhere if the Terms of Service change. We agree with Coppola and Neelley (2004) that the open source model promotes freedom of choice, increases user access and control, encourages collaboration within the global community, promotes quality, and enhances innovation in teaching and learning.

In the educational process within the afore-mentioned courses, we use GRASS GIS and Quantum GIS as the professional GIS software. The LMS system is represented by the Learning Platform Moodle. Students have to choose which operating system suits them best; they can use various Linux distributions as well as MS Windows or Mac OS X (Figure 1).

Geospatial data stored on the lab server are available for students as WMS or WFS layers through an API of the GeoServer application. For large raster data we use MEGA for cloud storage, due to its storage space and sufficient bandwidth. It also adds additional file encryption, saves part of server capacity and slightly lessens internet upload fees for the university. For raster data acquisition by students it is not necessary to create an account in the cloud service.One of the prominent concerns is data security and privacy in cloud storage due to data outsourcing (Mell and Grance, 2011). Students have to submit their data to the cloud server for storage and business operation, while the cloud server is usually a commercial enterprise which cannot be totally trusted (Mell and Grance, 2011). That is why all our datasets are packed and stored in cloud using the AES-256 encryption method.

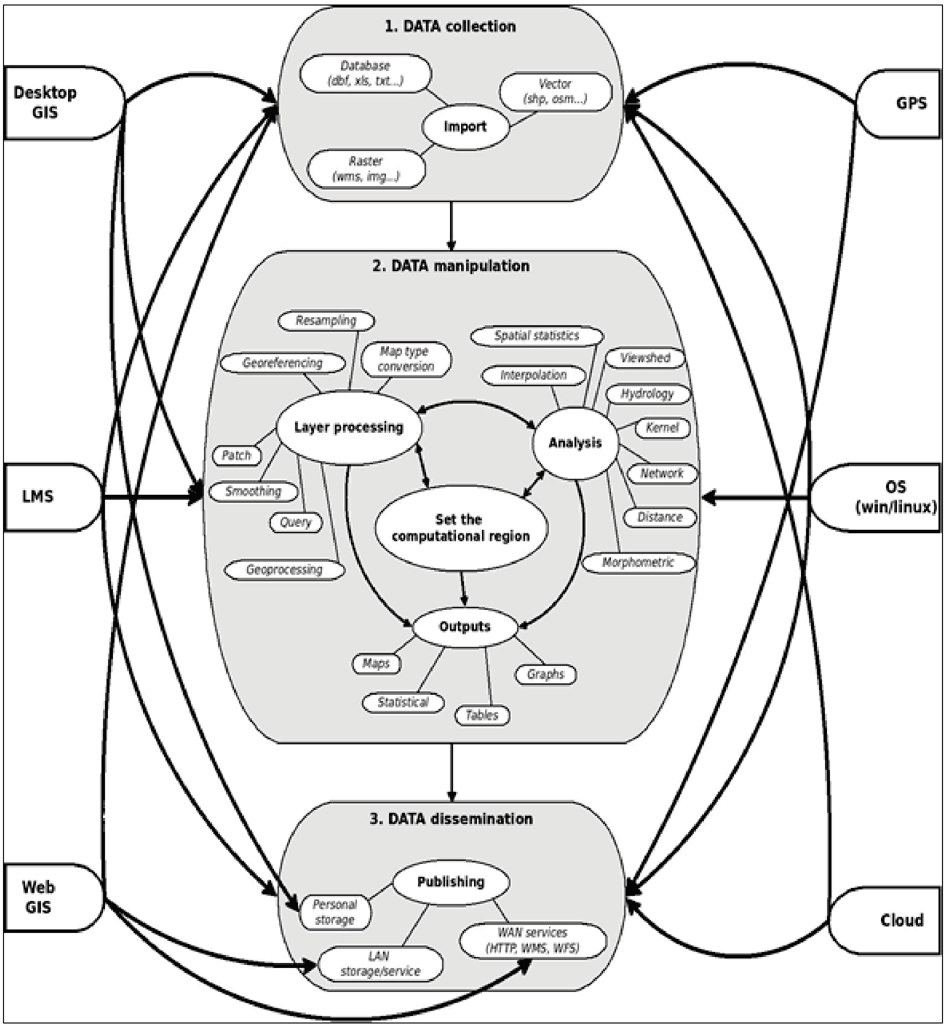


**Figure 1:** The logical sequence of steps, procedures and systems which students use to complete projects

The course curricula for Spatial Landscape Analysis and Advanced Analysis in GIS are based on problem solving for real scenarios that students will encounter in professional practice and which require the use of professional technologies, and a scientific approach. Therefore, we propose an educational model that uses an Inquiry-based learning (IBL) approach, which is, according to Dewey, (1994) based on the idea that science education should be authentic to science practice. Participation in inquiry can provide students with the opportunity to achieve three interrelated learning objectives: the development of general inquiry abilities, the acquisition of specific investigation skills, and the understanding of scientific concepts and principles (Edelson et al., 1999; Hmelo-Silver et al., 2007).

IBL is student-centred, incorporating an active learning approach focused on questioning, critical thinking, and problem solving. IBL is frequently used in science education and encourages a hands-on approach where students practice the scientific method on authentic problems (Ertmer, 2015).

## 3. Result

Based on the principles of IBL (Dewey, 1964; Feletti, 1993; Hmelo-Silver et al., 2007; Ertmer, 2015) we have created a model of an IBL approach to spatial landscape analysis for 1st year students of our master degree study program in ES.

This proposal outlines the course content as well as approaches for the implementation of this teaching style in the optional courses Spatial Landscape Analysis and Advanced Analysis in GIS. We have prepared 12 different problem scenarios during the two semesters, which require an IBL approach.

The same steps are used to solve each problem. (Figure 1). The learning objectives are achieved via a blended learning approach, based on a concept of integrating the strengths of synchronous (face-to-face) and asynchronous (text-based Internet) learning activities. At the same time, there is considerable complexity in its implementation with the challenge of virtually limitless design possibilities and applicability to myriad contexts (Garrison and Kanuka, 2004).

According to Feletti (1993); Hmelo-Silver et al. (2007) and Ertmer (2015), we start IBL with an introduction to the authentic problem scenario, which will be addressed using various research methods. Introduction of the situation is followed by a discussion (Edelson 1999, Feletti, 1993). Searching for the appropriate and optimal solution is a part of the educational process of IBL.

The work on the project, which uses ICT, begins by data collection and importing the necessary data to the GIS database or GIS project. This step requires clarification of several basic questions:

***What is the border of the area of interest and computational area?***

This first question is necessary for determination of the area of interest where the geospatial data will be processed. In some cases (e.g. hydrologic analysis) the phenomena within the area of interest can be affected by the surrounding landscape. In these cases it is necessary to set larger borders of computational area, however the area of interest is smaller than the computational area.

***Which input data are needed for problem solving and answers to the questions that arise from the situation set?***

While solving the problems, students may benefit from a variety of content and data, including those which they are able to create for themselves. They have access to the requested rasters using web links stored in a layers table and a password table distributed during the course. Other data, which do not take up a lot of space are accessible via GeoServer. Students can use the data with varying content depending on data accessibility or they can use their own skills for creation of the required data. They can also use existing data, which are available at the Department of Ecology and Environmental Sciences. Other possible options for obtaining data include: data available via WMS and data created by the students using various direct or indirect methods of spatial data acquisition, according to Jackson and Woodsford (1991).

***Which methods of spatial data acquisition are used?***

Digitalization of map sources and creation of new map layers via spatial analysis within the frame of derived mapping is an indirect method commonly used for geospatial data acquisition. Direct methods of spatial data acquisition are localization of objects and phenomena with GPS. When the input data, essential information for the project, and problems are defined, it is important to specify the attributes of the environment from which the geospatial data will be obtained and where the spatial analysis will be done. This step is closely related to data modification, necessary for further data processing.

The data modification gives rise to several questions as follows:

***What scale and resolution are used for data processing? What level of generalization of creating map layers is used?***

Selection of scale and the level of generalisation of map layers are very important steps. Map generalization is the name of the process that simplifies the representation of geographical data, to produce a map at a certain scale with a defined and readable legend (Ruas, 2008). Along with specific allocation of region boundaries, it is necessary to define the resolution in which all future operations will be performed. Resolution selection depends on the size of the area of interest, the desired degree of detail (generalization), but also on workstation performance, as upscaling increases demands on computer performance.

***What is the form of representation of data type?***

There are two basic forms of representation of Geospatial data in GIS: vector and raster form (Couclelis, 1992). Students work with both forms of spatial data representation during the problem solving process. Each form offers different possibilities and means of data processing as well as different possibilities of spatial data use.

***Which coordinate system is used for outputs?***

***M***ost of the inquiry-based problem solutions use geospatial data, georeferenced in local or global coordinate systems. Sometimes transformation of coordinate systems is necessary. Global coordinate systems are specific for the data obtained by GPS localization as well as for geospatial data available via WMS, and for the larger areas (e.g. Europe, world). Geospatial data on a national level uses a local coordinate system (Slovakia has Coordinate system S-JTSK). Local coordinate systems should be accepted and used either to calculate the position more precisely or to synchronize events (Munoz et al., 2009). Therefore, due to the unification of coordinate systems we will transform all layers into the S-JTSK coordinate system.

After answering the basic questions, considering the general setting of computational region, coordinate system, borders of the area and resolution, we can start mapping layer processing, spatial analysis and creating map outputs. All three operations are not always present in problem solving, some solutions require only analysis without modification of map layers. Other cases require only modifications of map layers without spatial analysis or several following modifications of analysis.

When the time-consuming analysis is completed, it is often necessary to change the resolution to make computations more rapid. On the other hand, outputs creation can bring valuable outputs from every step in this phase (modification of layers or analysis) and therefore it is not possible to integrate output creation only into the final phase. Work on modification of map layers, spatial analysis and outputs opens more questions which require our attention:

***Do the map layers need another, additional modification?***

Basic modification of the map vector layer is filtration and query resulted in the features, which fulfil our spatial or attribute conditions. The other modifications can be map layers overlapping (e.g. join, difference and intersection). Raster layers often require additional modifications, e.g. simple overlay and assembling of map layers, filtrations, smoothing. For instance a digital relief model from WMS can often contain data errors. That is why convenient tools (e.g. smoothing, interpolation) for elimination of the errors are necessary. If we want to unify resolution of several concurrently used map layers, it is useful to resample selected raster layers into the resolution required. Specific modification of layers is often used to convert from raster to vector format or *vice versa*.

***Which spatial analyses can be used in problem solving and in which order?***

The true power of GIS lies in spatial analysis. GIS makes spatial analysis (geographic and location analysis) easier, so the number of GIS application users increases and the scope expands (Audet and Ludwing, 2000). GIS analysis shows patterns, relationships, and trends in geographical data that help one understand how the world works, make the best choice from among options, or plans for the future (Mitchel, 1999). Spatial analysis represents the basic educational content of courses in which the IBL model is implemented, and therefore the analysis needs enough attention. The content in the spatial analysis course is divided equally into 12 problem situations and each new situation or lecture requires a knowledge of the previous situations, in addition to learning the new one. This type of learning allows multiple revisions of the analyses, and students obtain not only the necessary knowledge and skills to use concrete analytical tools, but they also gain experience in the adequate use of the tools. This learning system facilitates the students in selection of the most appropriate analytical tools for the next problem scenario.

***What kind of outputs do we expect and in which form?***

The solutions can consist of map outputs, tables or graphs. Students usually work individually on the results, but in some cases the map layer results can be connected into one common result, depending on the requirements of the problem scenario. If a common output is used, students have to work as a group throughout the problem solving process and communicate through verbal communication and LMS Moodle chat to unify the output scale, generalization degree and procedural steps.

The last phase of dealing with the problem scenario is dissemination.

Large part of the data that students use to solve their tasks, are usually stored in their own repository (personal cloud or any other personal storage). As the evaluation process is finished, layers created by students (Figure 2) can be shared on the department geodatabase. Completed tasks can be uploaded for evaluation by the lecturer via SFTP client. Only part of the results are accessible within the university LAN and finished data, ready for publication, are available to the general public through HTTP, WMS or WFS. Layers created by students are mostly vectors, created by direct methods (application of GPS, digitalization) and by derived mapping (results of spatial analysis). Data dissemination is provided through GeoServer, which serves as an information hub linking different data sources (vector files, database, raster data) and makes them accessible via Web services.

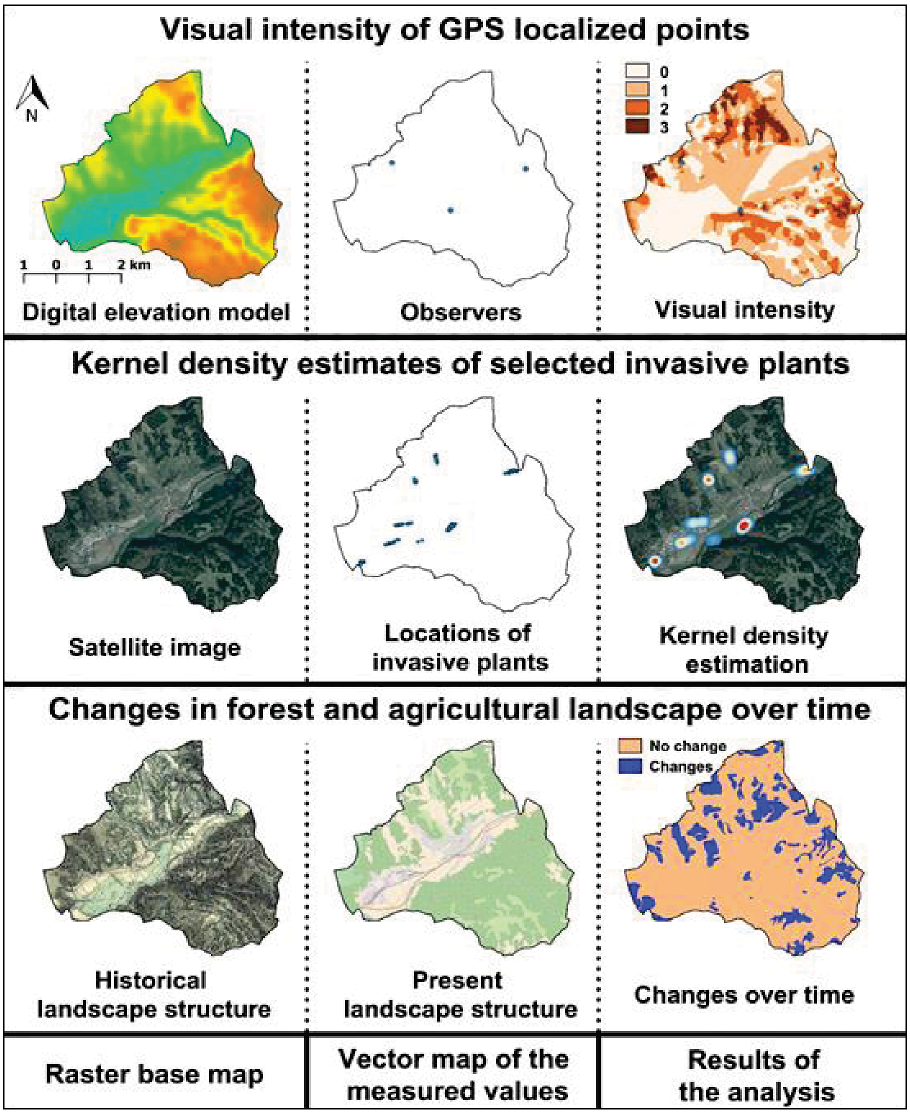


**Figure 2:** Examples of problem tasks solved by students

## 4. Discussion

Knowledge of the content and process aspects of the model design, as well as previous experience with implementation of IBL, allows us to suggest some ideas and recommendations for teaching using this method. Teaching using IBL is based on the following principles:

### 4.1 Scientific solutions for authentic problem scenarios, which come from the curriculum.

IBL gives students the opportunity to solve real-life problems using scientific methods. The course content of the proposed model is oriented on spatial analysis. The analytical tools and processes used in these optional courses are selected with the learning objectives of the curriculum in mind and from real problems, which graduates will encounter in professional practice. Moreover, IBL brings another practical dimension to these practical oriented courses - from a *„Research-oriented" to a „Research-based" education,* where according to Griffiths (2004) students learn as researchers, the curriculum is largely designed around inquiry-based activities, and the division of roles between teacher and student is minimised.

In our case, inquiry-based activities aim to teach:

- Selection and use of correct scientific procedures and methods
- Performance of effective spatial analysis, which can contribute towards more efficient problem-solving
- Use of effective analytical tools and their correct setting for the desired purpose.

Arising from the nature of IBL, inquiry in this case has a scientific basis and is focused on finding solutions with the highest validity and reliability. The question of validity and reliability represents a key criterion for evaluation of students' outputs.

### 4.2 Use of IBL and ICT for higher students´ motivation to learn

The proposed model combines IBL and ICT toward a common unified goal - to make teaching of spatial analysis more efficient and modern. In our model, IBL represents a student-centred, active learning approach, according to Ertmer (2015) and ICT contributes to changing the overall educational structure (Moran et al., 1999 cited in Anderson, 2005). We agree with Rose (2009) and Livingstone (2012) that ICT skills are becoming accepted as a third life skill alongside literacy and numeracy.

According to Gaible et al. (2011) students are frequently ready to benefit from instructional methods, therefore use of ICT in the educational process does not present any problem for them.

Students' orientation towards ICT is therefore best viewed in relation not only to their needs for social networking and leisure use of technologies, but also in relation to the way in which ICT is used in relevant areas of employment (Edmund et al., 2012). So ICT becomes an efficient medium (LMS Moodle in our case) for dissemination of educational content and a convenient way to increase student motivation to learn. In our case, ICT is used along with professional software, creating a new, positive association with technologies that are relevant to their future employment.

### 4.3 Development of a wide range of key competences

Our model is focused on solving authentic problems using professional systems and real data. Students have to find solutions for the problems posed by solving individual tasks, using real data and professional systems such as GIS, GPS and WMS (Figure 2). These modern methods of processing and analyzing data are highly sought after in practice, so graduates acquire disciplinary subject knowledge and skills that enhance their attractiveness on the job market.

A key advantage of GIS is its cross-disciplinary nature which promotes the development of a wide range of key competences. Proper use of GIS requires knowledge of geography, geoinformatics, cartography, mathematics, and database systems. The problem scenario itself enhances cross-disciplinary skill development, whereas finding a solution requires knowledge of ecology or ES. Besides gaining knowledge, in IBL students develop a number of skills: scientific inquiry skills, critical thinking skills and self-regulation skills (van Joolingen et al., 2005). Active use of ICT develops skills associated with information and communication technology.

### 4.4 Problem-solving is predominantly student-driven

According to (Thomas, 2000) problem-solving should be predominantly student-driven. IBL problems (question, situation) are not, in the main, teacher-led, scripted, or packaged. Within our model, projects do not end with a predetermined outcome or take predetermined paths. IBL incorporates a good deal more student autonomy, choice, unsupervised work time, and responsibility than traditional instruction and traditional projects. Figure 1 contains a diagram describing the logical sequence of the project implementation steps, but at every step the student has the opportunity to choose from a variety of GIS tools and settings to use for solving the problem. Fieldwork (direct GPS location of points) is also beneficial for problem solving. Data collection from the field increases the attractiveness of this type of learning approach for students.

## 5. Conclusion

Based on the principles of IBL we have created a model of GIS education for 1st year students of our master degree study program in ES. The model is designed for the courses of Spatial Landscape Analysis and Advanced GIS Analysis. The curriculum incorporates the use of ES alongside professional GIS software and other systems as well. While the GPS and WMS systems represent work with spatial data similar to GIS, Cloud is used for exchanging and sharing students' outputs and LMS presents a valuable information source for students as well as an instrument for communication between teacher and student and between the students themselves during work on projects.

Our proposed Model of GIS education is based on real-life problems, using the IBL approach and ICT to increase student motivation. Students will work with professional tools and real data, and the educational process will have an interdisciplinary approach which develops a wide range of knowledge and acquired skills. The real-life problems, which are solved during the educational process, are significantly student-driven. The role of teacher is that of a classroom manager. A similar approach in education can also be used in other branches of science.

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# Dynamic Models Using 3D Projection

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**Abstract**: Dynamic models have become common in mathematics classrooms. However, their use is often limited to work in plane. This despite the fact that modern technology offers the possibility to work in space. The author presents the potential that 3D projections using anaglyphs offer when teaching geometry in space. He builds on his experience from work with a dynamic geometry programme as well as from his experience from pre-service mathematics teacher education. Solid geometry is one of the fundamental parts of mathematics. The ability to solve geometrical problems is closely connected to spatial imagination. Currently we can observe that pupils and students at all school levels find it more and more difficult to solve spatial problems, as they cannot visualize, make a mental image of the situation. Contemporary children do not manipulate with objects as much as children did in the past and thus lack a sufficient idea of their properties and behaviour. This paper presents those functions of a freeware dynamic geometry programme – GeoGebra that allow 3D projections using anaglyphs. Anaglyphs have been known since mid-19$^{th}$ century. The first learning materials using anaglyphs were published decades ago. Despite this these tools have not become widespread. One of the reasons might be that teachers and learners were confined to the use of ready-made materials that could not be modified. Teachers also could not create materials on their own. Thanks to dynamic geometry programmes this is no longer true. Teachers and pupils now have the chance not only to create their own anaglyphic images and films but also to manipulate with the created objects – to view them in space, rotate them and change their properties in real time by manipulating parameters. The aim of this paper is to point out some possibilities these technologies have for mathematics and mathematics teacher education. The paper presents different types of using anaglyphs in mathematics classrooms.

**Keywords:** 3D models, anaglyph, GeoGebra, stereoscopic projection, stereometry, mathematics, education

## 1. Introduction

Mathematics and its teaching have been closely connected to computers from the very start. Recent developments of computers allow us to use them not only for calculations but also for displaying data graphically, both in static and dynamic form. The computer has become an important aid not only when teaching algebra and calculus but also geometry. Dynamic geometry environment (DGE) and dynamic models have become common in some mathematics classrooms. Most often they are used in plane. However, modern technology also allows work in space. In the paper the potential of 3D projections will be shown on the possibilities the programme GeoGebra offers. GeoGebra is currently one of the most used programmes from the DGE group. It also allows work with three dimensional objects and their 3D projection.

## 2. Mathematics education and computers

Introduction of computers into mathematics education at schools was a gradual process. The first experiments with the use of computers in teaching mathematics were limited to a very narrow group of people to whom technology was accessible (see Taylor, 1980). Computers became more widespread later, in the fourth generation, which is characterised by the microchip and personal computers. The beginnings of massive use of computers in our society and schools can be dated to the 1980s. It comes as no surprise that at this time mathematics educators became interested in the issue of the use of computers in mathematics lessons. Computer science and mathematics are very closely connected science disciplines and the use of computers in teaching mathematics is a logical outcome of these connections. Use of ICT in mathematics lessons was addressed also by one of the first conferences organised by ICMI (International Commission on Mathematical Instruction, part of International Mathematical Union), with the title The Influence of Computers and Informatics on Mathematics and its Teaching (Churchhouse, 1986). The proceedings of this conference feature papers on all important trends in the area of computers in mathematics lessons that could be come across in the 1980s.

The constantly improving performance of computer technology enables more ways of its use in lessons. That is why the conclusions of ICMI conference needed amendments and revisions. The use of computers in teaching mathematics was addressed by ICMI study 17, entitled "Mathematics Education and Technology – Rethinking the Terrain" (Hoyles, Lagrange, 2010). This publication discusses not only the potential of new programmes (mainly tools for dynamic geometry and computer algebraic systems) but also new technologies (e.g. mobile devices). New issues have moved to the spotlight of interest – changes in curricula and changes in theoretical approach to the use of ICT in mathematics lessons. The use of computers in lessons in not only about how to teach mathematics in a better way but how to teach "better mathematics".

Although the use of computers in teaching has been in the centre of attention of expert community for more than 30 years, its global introduction to mathematics classrooms faces many obstacles and there are still many questions that will have to be answered.

### 2.1 Dynamic geometry environment

One of the areas that has recently attracted a lot of attention in research of use of computers in teaching mathematics is dynamic geometry environment. Dynamic geometry programmes (DG) also referred to as dynamic geometry environments (DGE) or interactive geometry (IG) are programmes that enable geometrical constructions. Most dynamic geometry programmes can be used for work in plane. However, some of them allow constructions in space.

Development of dynamic geometry programmes started in the beginnings of the 1980s. The first dynamic geometry programme was Geometric Supposer (Schwartz, Yerushalmy, Wilson, 1993). Currently there are dozens of dynamic geometry programmes for work in plane and about ten programmes that allow work in space. From the very beginnings, dynamic geometry programmes have been developed for teaching geometry at schools. Their use in mathematics lessons helps development of geometrical imagination (Battista, 2007), it supports development of thinking and understanding and broadens the scope of activities and problem solving (Vaníček, 2009). These programmes support development of geometrical thinking (Laborde et al., 2006).

Typical use of dynamic geometry programmes in lessons very often fails to make full use of the potential the programmes offer. Teachers very often work only with classical (static) geometrical constructions. When used correctly, dynamic geometry environment teach pupils to be accurate, as they enable the construction to be transferred into a new situation with a different assignment. Thanks to this pupils get a much better insight into the situation and understand constructions better. In some cases this deeper understanding of the situation results in pupils' ability to justify the construction and prove its correctness (Marrioti, 2000). Thus dynamic geometry environment can become a natural bridge between intuitive approach and world of mathematics based on axioms, definitions and proofs.

Dynamic geometry environment also allows us to solve new types of problems. Dynamic geometry brings a "third dimension" into plane – motion (Koman, 2000). Thus a brand new environment of dynamic mathematics is created (Hohenwarter & Preiner, 2007) that allows pupils to inquire and discover using dynamic models (Jančařík, 2015).

### 2.2 Dynamic geometry environment at schools

At the beginning of the 21st century, Cabri was the most widespread dynamic geometry programme for plane geometry in Central European schools. This has changed and the most widespread programme now is the freeware programme GeoGebra. Similarly in space the dominant Cabri 3D programme has gradually been replaced by GeoGebra. However, 3D projection is supported only by versions 5.0 and higher.

### 2.3 GeoGebra

GeoGebra is a multiplatform dynamic software designed for all levels of education. The programme combines geometry, algebra, tables, graphs, statistics and infinitesimal calculus. GeoGebra is Open source software freely available to non-commercial users and is now used by millions of people all around the world. Currently it is offered in versions both for personal computers (operation systems Windows, Mac OS, Linux) and for tablets (Apple, Android, Windows). Version 5 and higher allow work with 3D objects, including their stereoscopic projection using anaglyphs.

## 3. Anaglyph

Anaglyph is one of the stereoscopic techniques that allow its users to view pictures, photographs, graphs, films and other graphical objects three dimensionally. An anaglyph consists of two projections of an object in space in central perspective, they are drawn in complementary colours. They are viewed through a pair of eyepieces of corresponding complementary colours. The resulting picture, obtained by amalgamation of two pictures, gives the impression of a figure in three dimensions Struick (2011, p. 215). The most common colour filters used are red and cyan.

Construction of anaglyphs has been known since mid-19th century (Rollmann, 1853). The mathematical apparatus needed for construction of anaglyphs was described at the beginning of the 20th century (Vuibert, 1912). Anaglyphs (including, among others, aerial, telescopic, and microscopic images) are applied to scientific research, popular science, and higher education (Hortolà, 2009, according Wikipedia.org).

The term "3-D" connected to anaglyphs was coined in the 1950s. In 1953, the anaglyph had begun appearing in newspapers, magazines and comic books. The 3-D comic books were one of the most interesting applications of anaglyph to printing (from wikipedia.org). At that time, also the first textbooks using anaglyphs appeared.

## 3.1 Dynamic anaglyphs

Anaglyphs are not used only for static images. The first three-dimensional anaglyph motion picture was created by William Friese-Green at the end of the 19th century. The first films using anaglyphs were made in the 1920s. Anaglyphs became very popular in the 1950s. In the 1970s the filmmaker Stephen Gibson filmed direct anaglyph blaxploitation and adult movies. He had this technology patented. Currently movie industry prefers other technologies for making 3D films. Still, for example on YouTube there are many films made with anaglyphs.

## 3.2 Methods of projection

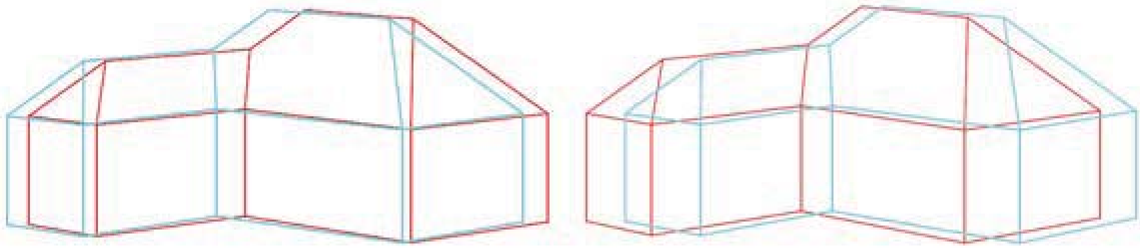

**Figure 1**: Mapping in front of and behind projection (Matěková, 2012)

Three types of projections are used for creation of 3D images.

Two of them are used predominantly for projections on monitor or wall. In these the images are displayed either in front of or behind the projection (see figure 1). This projection is made in a way that the 3D effect is perceptible by a viewer standing in front.

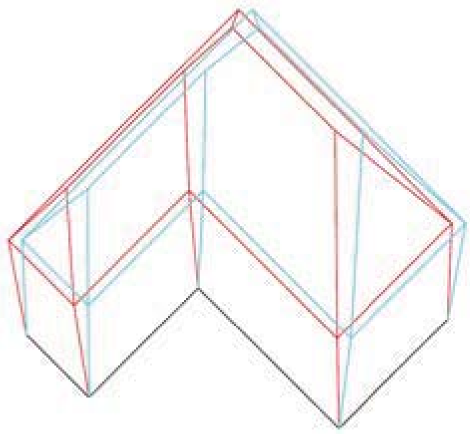

**Figure 2:** Anaglyph on the floor plan (Matěková, 2012)

In printed materials, anaglyph in the floor plan is used. This allows to put the image down and view it from the top.

### 3.3 Anaglyphs and mathematics education

Steiner states (2013, p.125) that the anaglyph is comparatively cheap, and easily stored. Thus it comes as no surprise that anaglyphs were used in textbooks of mathematics, especially geometry. The first Czech learning text with anaglyphs was published by R. Pruener as a supplement to the textbook of descriptive geometry for upper secondary grammar schools already in 1941. From 1941 to 1963, the same author published a number of other learning texts using anaglyphs. As far as the author of this paper is informed, no other Czech learning text using anaglyphs for mathematics education was published after 1963. However, anaglyph images were used e.g. in journals for young technicians.

The question is why anaglyphs disappeared from printed mathematics learning materials. One of the reasons may be that it is important that a stereoscopic technical illustration must be of the highest technical quality, otherwise some viewers cannot see the image at all Steiner (2013). The printed materials needed very high quality printing in colour. Also the teacher could only work with a limited number of materials. Creation of anaglyphs by teachers and learners without computer technology was extremely demanding, if not impossible. This has changed thanks to new high quality software that facilitates creation of anaglyphs. In the following text the functions and potential of the programme GeoGebra are presented in more detail. It is one of the programmes that allows construction of high quality anaglyphs and is now used by many mathematics teachers and their pupils.

## 4. Programme GeoGebra

The programme GeoGebra is one of the tools from the group DGE. Its basic property is that all the created constructions are dynamic. This applies also to 3D constructions. The user can change input parameters in real time and observe effects of these changes on the whole construction. A typical example from solid geometry is cross section of a solid (its intersection with a plane). The programme GeoGebra allows not only construction of this cross section (step by step) but also changes in the position of the intersecting plane. The user can then observe how this affects the shape of the cross section.

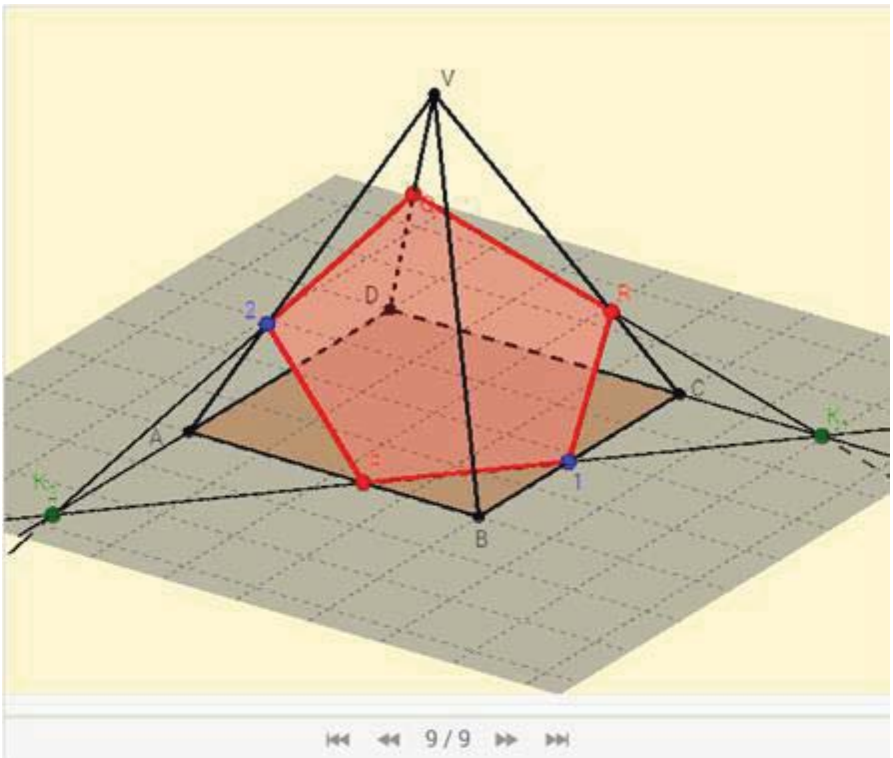


**Figure 3**: Example of construction of a cross-section

An example of such construction is in the figure. The pupils can change the position of red points (QPR) and at the same time make a sequence of cross section construction using the arrows below the picture. Pupils may also rotate the pyramid and view it from different perspectives.

### 4.1 Different projection planes

The programme GeoGebra allows not only to view the model we are working with but also to work on several projection planes at the same time. The use of this function is illustrated in the figure below. It shows the construction of a pyramid cross-section by a plane parallel to its base. The pupil can move the intersecting plane. On auxiliary projection planes in different views, the pupils simultaneously sees the floor plan, side view of the situation and the shape of the cross section.

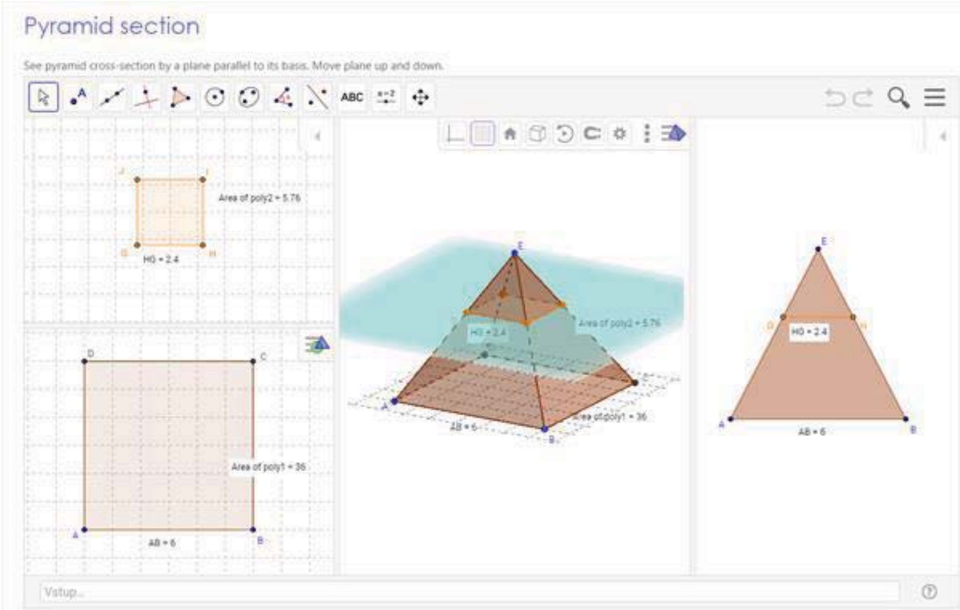


**Figure 4**: Pyramid section with auxiliary projection planes

The combination of different views of the same situation can make pupils and students understand illustrations used in textbooks better. Rotation of the model helps them understand the situation better.

### 4.2 Use of anaglyphs

The programme GeoGebra offers 4 types of projections of 3D models. One of them is based on the use of anaglyphs. This projection and the use colour coded glasses brings about stereoscopic effect thanks to which the observed object looks three dimensional. Also in this projection the user may change all parameters of objects in real time. It is interesting to point out that even the mouse cursor is animated and stereoscopic. The user can thus follow movement of the cursor in space. And it is the movement of the cursor that tends to be problematic in other projections as it must be translated into motion in space.

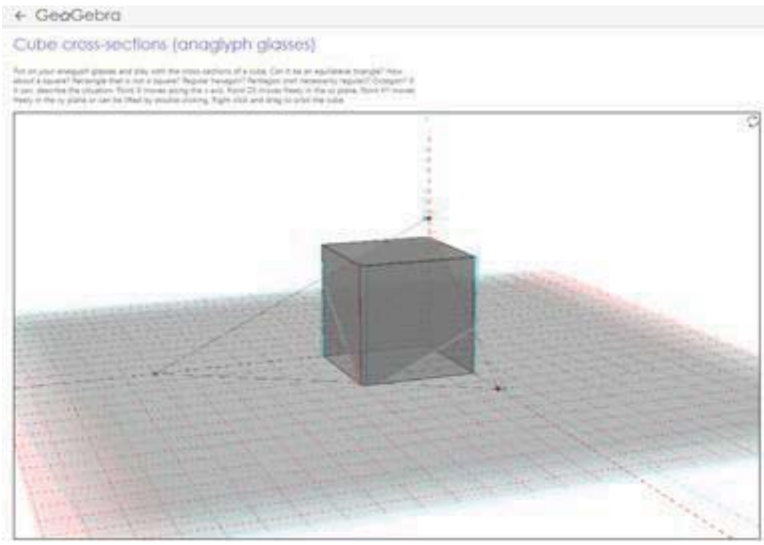


**Figure 5:** Cube cross-section to be used with anaglyph glasses

### 4.3 Available materials

3D teaching materials may be developed by teachers themselves but teachers can also use hundreds of materials that are freely available on the website GeoGebra.org. The materials are prepared in a way that they can be run directly in the web browser and do not require to have GeoGebra installed.

It is true that only very few of these use anaglyph projection. However, the user can download any of the materials and then simply change the type of 3D projection. Then the materials are ready for use with anaglyphs and glasses.

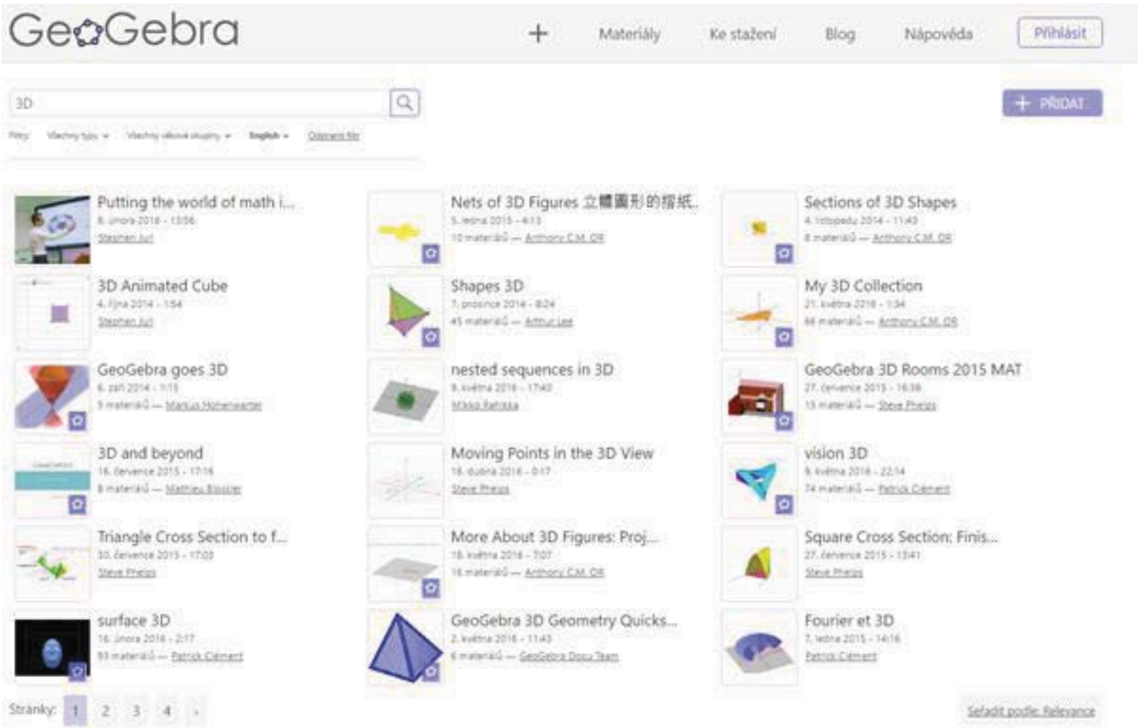


**Figure 6:** GeoGebra.org learning materials with 3D objects

Materials posted on the server GeoGebra.org show that 3D projection is a convenient tool not only for teaching solid geometry but also for example to show graphs of functions of more variables.

### 4.4 Technical setting

When working with 3D objects 3D Graphics must be turned on in the pane View (see figure 7). Then the user can set the type of projection to be used for 3D projection of 3D objects (see figure 9). The programme offers 4 types of projection:

- Orthographic
- Perspective
- Anaglyph
- Common view

The user can switch between different types of projection in all materials.

In some types of projection it is possible to select also other parameters. In anaglyphs it is the selection of the scale of grey and distance between the viewer's eyes. Ordinary anaglyphs are viewed with a pair of eye-pieces about 2½ inches apart Struick (2011, p. 215). The author's experience shows that this default setting suits most pupils both when working on the monitor and when projecting the image using a beamer. However, it can be changed for pupils who cannot amalgamate the two images into one in the default setting. The change allows even these pupils to see the 3D effect.

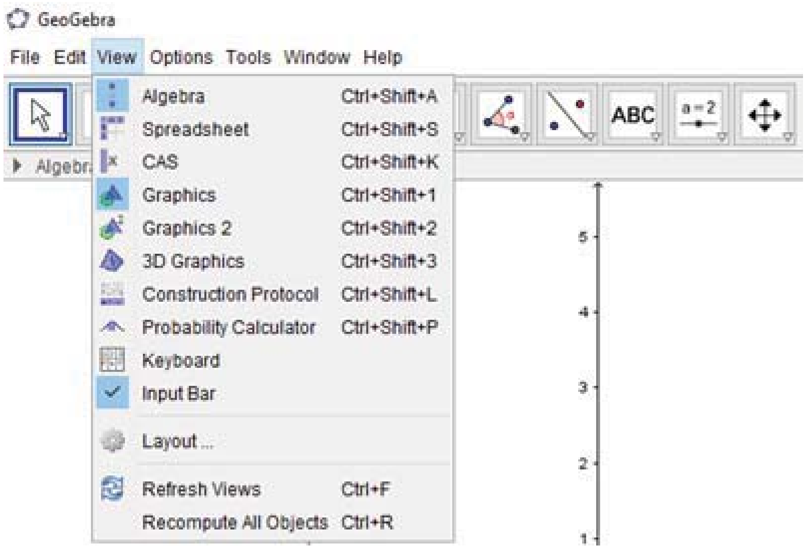


**Figure 7:** Programme GeoGebra – different types of view

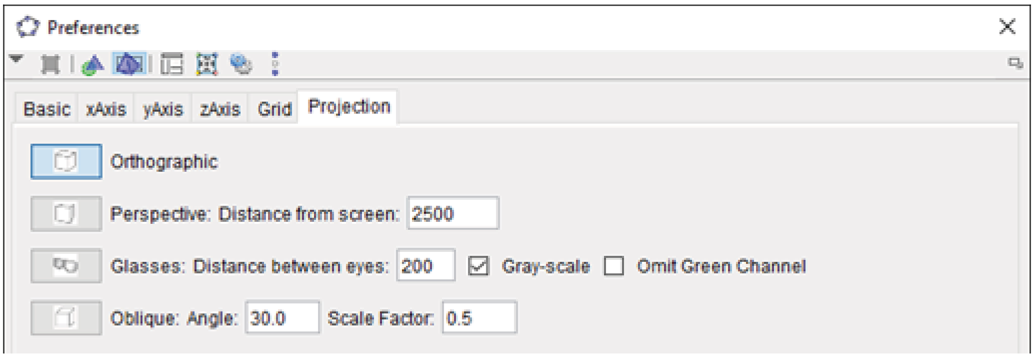


**Figure 8**: Programme GeoGebra, setting projection of 3D objects

### 4.5 Export of data

The programme GeoGebra offers two basic ways of saving created materials – in its own format GGB, for whose opening the programme GeoGebra must be installed but can also be run in web browser, or it may be saved as HTML file for which the programme need not be installed.

The programme GeoGebra also allows to export of images of created materials in various graphic formats (png, eps, …). If we want to record motion of objects on a trajectory, the programme GeoGebra offers creation of the picture in the format Animated GIF.

## 5. Use in pre-service teacher training

### 5.1 Use of the programme GeoGebra in teacher education

The author of this paper teaches pre-service teachers at the Faculty of Education, Charles University in Prague. Pre-service students are introduced to the programme GeGebra already in the first grade in the form of a course focusing on work with this programme (see below) as well as in other courses – both in the courses of geometry in plane and in space (Synthetic geometry I-III, Analytic Geometry I and II) and in courses that use other functions and potential of the programme (e.g. Linear algebra, Problem solving for secondary mathematics, Elementary mathematics). Direct use of the programme in mathematics courses motivates students to use the programme actively not only as a tool for their studies but also in problem solving.

Students' training in mathematics is followed by subject didactic training in which attention is paid to how to use the programme GeoGebra in lessons. Students learn about theoretical aspects of the use of GeoGebra in lesson planning and in mathematics lessons. They very often use the programme during their teaching practicum and also in their bachelor and diploma theses. Every year a number of students graduate from our department with a thesis focusing on the programme GeoGebra.

### 5.2 Teaching how to work with the programme GeoGebra

Pre-service teachers get acquainted with the programme GeoGebra in the course Mathematical Software, which is compulsory. This course is included in the first year of their studies, which allows students to use the programme in all other courses. In the course Mathematical Software students get introduced to 3D functions of the programme GeoGebra and anaglyphs are also part of the course. Students first learn how anaglyphs work and get used to watching them (with the help of animated films). Later they create dynamic applications using anaglyphs.

There is another course – Mathematical Software Project – that is a follow-up to the course Mathematical Software. In the latter course students develop a project - an essay, demonstrating their ability to work with a deeper understanding of ICT and to use it in teaching. Majority of the developed projects are based on work in the programme GeoGebra and its use in lessons. This course is compulsory for students whose only field of study is only teaching mathematics on secondary school level.

### 5.3 Student projects

Students do not work with the programme Geogebra only individually. There are also group activities. A grant has been awarded to students at the department this year. The goal of the financial support from this grant is development of teaching materials for geometry lessons using GeoGebra, including materials using anaglyphs. Students work under supervision of an expert in work with GeoGebra and expert in geometry. Students will gradually develop 15 applications for plane geometry and 15 application for 3D geometry using anaglyphs. Each application will consist of a solution of one more complex problem, i.e. its assignment, description and discussion of its solution, its animation. All this in the form of a dynamic application in which users will be able to change input parameters. All problem assignments are chosen in a way to make them good study materials for different courses.

## 6. Conclusion

Work with 3D reality and 3D objects is one of the trends that captures more and more attention of developers of computer technology. Without any doubt the results of this activity already have impact and will have even greater impact on all aspects of human life, including education. This paper focuses on the issue of how current technology may help teaching plane geometry using 3D projections. Anaglyph is one of the ways. Anaglyphs provides cheap and easily available-effective solution for 3D projection. The author describes the functions that are offered by the freeware programme GeoGebra. The author builds on his own experience of work with this programme and on experience from pre-service teacher training where he uses the programme. His experience with this programme shows that the functions offered by the programme GeoGebra help to develop pupils' spatial imagination. The product is used more and more both by teachers and pupils in lessons and pre- and in-service teachers are actively involved in creation of new teaching materials. Pre-service teachers thus have the chance to try the programme both as students and as developers of teaching materials. Most of them plan to use this product actively when they start their teaching career.

3D virtual reality has an enormous potential to influence teaching (not only of mathematics) at all school levels. However, research of this phenomenon and its impact on teaching is in the cradle and deserves due attention of IT specialists as well as teacher educators. The aim of this paper was to point out some possibilities these technologies have for mathematics and mathematics teacher education.

## Acknowledgements

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# Work With Models in e-Learning Environments

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**Abstract:** PISA study has defined several key areas to be paid attention to by teachers. One of these areas is work with models. The term model can be understood very broadly, it can refer to a drawing of a chemical reaction, a plastic model, a permanent mount (taxidermy) to advanced 3D projections. Teachers are no longer confined to teaching materials and aids available physically at schools. Thanks to information technology, models can be included in lessons almost without any limits. However, work with models is very specific due to the simple fact that a model always differs from what it represents. Efficiency of education using ICT can be affected negatively in case that work with complex models requires high level of abstraction which pupils are not capable of (Harrison, Treagust, 2000). Jančaříková (2015) points out that – due to the demands on upper secondary pupils – children must be taught how to relate models to real objects from very early stages. Linking an object to its model – isomorphism is the basis for successful work with models. Work with models thus must be developed systematically and consistently and included into teaching of younger learners. The scope of work with models in natural sciences is gradually increasing. There are some phenomena that are ungraspable without a model, e.g. DNA double helix. However, the fact that we are able to project these models to pupils using information technology does not mean that pupils will be able to understand them. In this paper we want to point out that not enough attention is paid to work with models (not only in the Czech Republic) – methodology of work with models does not exist and is not taught to pre-service teachers. The paper classifies types of models we come across in lessons, describes basic differences between objects and reality they represent and proposes possible ways of systematic inclusion of models into teaching

**Keywords**: models, projection, science education, 3D projections, interactive models

## 1. Introduction

It is becoming more and more common that natural scientists study phenomena which are not tangible and cannot be observed with our own eyes (e.g. DNA double helix, cell, atom). Natural scientists make hypotheses about functions and structures of particles, organelles or phenomena that take place on or in them. These hypotheses are verified using models and computer simulations.

The verified knowledge is then transformed into curricula of different natural sciences. Virtual environments allow teachers to present this new knowledge to pupils and students in a relatively simple way.

However, very specific demands are put on pupils if they are to understand a projection or a model transformed into 2D form on a monitor. The need of scientific abstraction grows, namely the ability to work with models, projections and especially computer simulations in virtual environments. These demands are even higher if the pupil works with computer models in absence of a teacher, e.g. in self-study using e-learning. The more complex a model is, the more abstract thinking is needed to understand it. PISA studies show that work with models is very difficult for pupils and due to their deficient ability to abstract some pupils fail to understand what real object a model represents. Then they fail to grasp the phenomena going on in these objects.

This topic has not yet been paid enough attention by expert community. That is why we decided to focus on it in our research.

## 2. Learning theories, abstraction and models

### 2.1 Piaget and abstraction

Contemporary theories of learning very often come out of Piaget's claim (Piaget, 1979, p. 23) that knowledge does not result from a mere recording of observation without structuring activity on the part of the subject. Piaget explained that knowledge proceeds neither solely from the experience of objects nor from an innate programming performed in the subject but from successive constructions (Piaget, 1977, preface). This means that assimilation and reflective abstraction play a key role in the learning process.

Learning does not occur and cannot occur without a pupil's or a student's activity. When studying a new object or process, the pupil or student must be able to find the signs which link the studied object or process to already familiar objects and processes or must be able to see how they differ from these. With the help of generalization or abstraction the pupil or the student constructs qualitatively higher-level knowledge that incorporates the already acquired knowledge and allows its application on yet unfamiliar objects (Hejný, 2004). This process may repeat and pieces of knowledge are linked on various levels.

Models used in lessons support the process of cognition on several levels:

- they represent real objects, often those that cannot be reached easily, they allow learners to grasp these objects, their functions and processes that take place in or on them ,
- they allow learns to make links between the studied objects and already acquired knowledge (analysis and synthesis of knowledge), which is followed by construction of a new concept in their minds,
- they develop abstract thinking, pupils learn to create isomorphism (see Slavík, 2004).

## 2.2 Classification of models according to the level of abstraction

With respect to the relationship between a model and a real object we can classify models in a broader sense for didactical purposes according to the level of abstraction that is needed to grasp them (adapted according to Harrison, Treagust, 2000) as follows:

- models of easily accessible objects
- models that allow pupils to see, observe, "feel" objects that are usually not accessible
- models that require abstraction
- models that represent theoretical knowledge; work with them requires not only abstraction but also relativism

### *2.2.1 Models of easily accessible objects*

These are models representing animals, plants and other products of nature, objects that children can see in vivo (e.g. models of earthworms, ants, flowers, common Czech mushrooms etc.). Models should first be the same size as real objects, later they can differ in size, can be enlarged if the observed object is too small (ant, flower) or reduced if the observed object is too big (e.g. giraffe). In fact, plush, plastic or wooden toys are also models if they are faithful representations of products of nature.

### *2.2.2 Models that allow pupils to see, observe, "feel" objects that are usually not accessible*

These are models of products of nature, animals and plants or their parts, common objects that cannot be manipulated in real life for various reasons, are accessible with difficulty or completely inaccessible (at least to young learners), or models that allow manipulation impossible with real objects.

An example may be a model of an anthill that shows a section through this anthill and allows pupils to observe what is inside without actually destroying it.

### *2.2.3 Models that require abstraction*

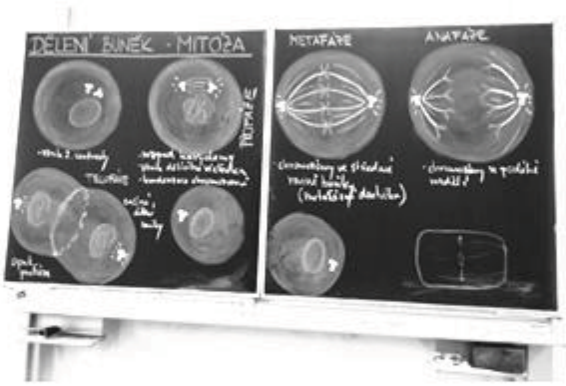


**Figure 1:** Schema of mitosis, Waldorf lyceum in Prague (Svobodová, 2016)

These are models of objects that are inaccessible to most people, e.g. the above mentioned model of a DNA double helix or models of cells or processes going on in a cell (mitosis). Pupils should be expected to work with models requiring abstraction only after thorough training, i.e. after consistent and methodical work with models from previous categories. However, this is often not the case in school practice.

*2.2.4 Models that represent theoretical knowledge; work with them requires not only abstraction but also relativism*


**Figure 2:** 3D Model of methanol (non-space filling and space filling) from the programme Wolfram|Alpha

A specific category are models representing newest theories that have not yet been empirically verified. An example of these are e.g. models of atoms or solar system as they were changing through history.

Models of this category are used to verify and improve theories on how a phenomenon works. A model of an atom is not meant to reflect its real shape but to highlight certain properties and relationships between the particles the atom consist of. In abstract models, the model always shows only some part of reality. Thus in history of natural sciences one can come across paradoxes in scientists' interpretations and the models they use; for example, light as waves versus light as particles (photons) (see Fosnot, 1996).

## 2.3 Work with models in natural sciences

PISA (Janík, Stuchlíková, 2010) defined work with models (in the broader sense, i.e. including two dimensional projections, computer simulations etc.) as one of the problematic areas in science education. We believe this to be caused by the fact that work with models cannot be grasped at once, it needs to be developed consistently and methodologically from very early ages. If a biology teacher projects a complex two-dimensional picture of a complex model (e.g. DNA double helix) without any previous work with models to their pupils, the teaching cannot be efficient and weaker pupils will get *completely lost* in the topic.

If a model is to be understood efficiently, it must be related to the real object it represents. This connection is called isomorphism (Slavík, 2004). It is thanks to isomorphism that pupils are able to understand a model and match its properties to the properties of real objects they are learning about. Our research in science education showed that Czech biology educators pay very little attention to work with models. Work with models is not a part of pre-service teacher training curricula and is not addressed by textbooks of science education (see e.g. Altman, 1974, Pavlasová, 2014, Řehák, 1967). Thus it is not surprising that teachers pay little attention to the topic and sometimes even lead pupils astray, for example by referring to a model of a cell as to a cell.

We also discovered that very few teachers pay attention to a systematic development of abstract thinking needed for grasping models and their meaning. Work with models is paid more systematic attention in the curricula of alternative schools (Montessori, Waldorf lyceum) than in state schools. Moreover, introduction of new technologies often results in replacing collections of models of products of nature by electronic teaching materials.

**Example**

A teacher, when asked why he was getting rid of pictures and models of products of nature from his office, replied that they were no longer needed as the school purchased computers and a beamer. His lessons were now based on PowerPoint presentations and he was using the Internet. Old aids were too large and their maintenance too difficult.

**Figure 3**: Models of flowers discarded in 2014

**Figure 4**: Using models in natural science by a 5th grader

This is wrong. Technical aids may help to learn knowledge of a topic, but one generally acknowledged didactical principle (Obst, 2006) states that the goal of an activity is not only knowledge but also other important learning objectives. These are appropriation of different methods of work, learning to work with different types of visualisation, getting experience of work with models, increase of environmental awareness, pleasure from discovery (Jančaříková, 2015). This implies that one of the objectives of education in natural sciences is development of the skill of isomorphism between a model and object, and of abstract thinking. To achieve this goal it is essential that pupils work with different types of visualisation. This must be done coherently and methodically. Physical models are an important step between real objects and their virtual visualization.

## 3. Guidelines to a practise

### 3.1 Types of models

With respect to their purpose, models in natural sciences can be divided into two basic groups – models of objects and models of relationships and processes. Both these categories are often connected and it may not be possible to separate them, e.g. the model Solar system does not only give information about planets but also gives a lot of information on their relationships, possible positions and orbits. On a higher level, a model of an atom is not so much its physical visualization (enlargement) but more a schematic illustration of relationships between the particles that make up an atom.

#### *3.1.1 Models of objects*

Models of objects can be divided into three basic categories. These are:

- Illustrations
- 3D models
- Collections of products of nature

Computer technology only allows models of the first two categories. We must never forget the importance of work with real objects and be aware of both the advantages and disadvantages of computer models and absence of real objects in lessons.

**Illustrations**

**Figure 5**: Illustrations owned by the Faculty of Education

Illustrations can be in colour or black and white. They also differ in size. They may require small or moderate degree of abstraction. Illustrations include drawings, paintings, photographs but also various types of projections.

Although it may seem the best way to represent products of nature is to use a photograph, it is not true. A scientific drawing can highlight the properties that are essential for determination of a species and thus depict the species more accurately.

**3D models**

By 3D models we understand objects that represent a selected natural entity. The teacher should deliberately present models from various materials (wood, plastic, plush), of different colours and sizes to pupils. Developments in technologies brought about interactivity of many of the models. Thanks to technologies pupils can observe three dimensional objects either by the means of stereoscopic projections or thanks to augmented reality (see Jancarik, 2016).

**Figure 6**: Selected aids used by the authors of this paper for development of abstract thinking and isomorphism in primary school pupils. Reduced models (models of solar system, of dinosaur and elephant), enlarged models (models of the life cycle of a ladybird, ant, stag-beetle, mosquito), models in the same size (models of a bat, germination ). Also representation of hatching and growing of a duck.

**Products of nature and natural materials**

Mounts are a specific kind of 3D models in a broader sense. Mounts can be temporary or permanent. Permanent mounts are for example staffed animals and their parts (skeleton, leg with claws etc.), herbarium items and collections (entomological collections, collections of minerals and rocks etc.) When exploring real natural mounts pupils use other senses (e.g. touch) and gain experience they would never gain from modern technology.

**Figure 7**: Biology collection of the Department of biology and environmental studies at Charles University in Prague, Faculty of Education

*3.1.2 Models of relationships and processes*

Similarly to models of objects, model of processes and relationships can be divided into categories as follows:

- Static schemas
- Dynamic schemas
- Interactive models

**Static schemas**

A static schema illustrates a relationship or a process a pupil is to learn. Static schemas require a high level of abstraction on the pupil's part as the progress of the process must be visualised by the pupil. On the other hand they allow us to describe and capture the main parts of a process and partially also the circumstances under which the process takes place. The internet provides an unlimited number of schemas describing processes and relationships.

**Dynamic schemas**

When using dynamic schemas, pupils may observe the course of a process (either directly or schematically). In case of dynamic schemas on computers the pupil can select which parts of the process will be displayed and can then observe the depiction of their course.

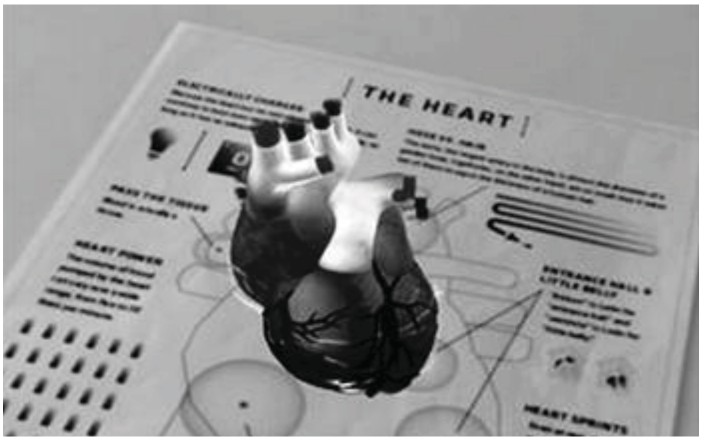


**Figure 8:** Human heart in the application Body 4D

Thanks to augmented reality used in the application Body 4D, pupils can view the activity of human heart, listen to heart beat, they can view it in different perspectives and at the same time choose one of its parts and select an activity of this part at the different phases of its activity.

**Interactive models**

Interactive models allow pupils not only to study the progress of an activity/process. Pupils can also influence the progress by changing various parameters. Interactive applications usually use mathematical models describing individual phenomena and their relationships. One of the best known examples is the simulation of fox and rabbit population foxes on a given territory. Pupils can choose more than the initial number of animals. They can also change the parameters affecting their number (Breed rate, Death rate).

## 3.2 How models differ from real objects

Models are not real objects, they only represent them. Work with models always requires abstraction. The following text first presents basic differences between models and real objects. Then models are classified according to the level of abstraction that is needed for their understanding.

### *3.2.1 Reality versus model*

Models that pupils meet always differ from reality. When working with models we must be aware of these differences and address these differences when introducing models in lessons. The most common differences between models and reality are the following:

- Schematization

- Different dimensions
- Different duration of the process
- Lack of stimuli for sensory perception
- Lack of variability

### *3.2.2 Schematization*

Many models use schematization. Some schemas are notoriously known in our culture (e.g. a circle surrounded by lines = sun). Other schemas require education and their mastery is the sign of expertise in some discipline (e.g. symbols for men and women, symbols used to describe flower patterns and also graphs and diagrams, e.g. climographs).

### *3.2.3 Dimensions*

A human as an observer has their physiological dispositions. This means that too big organisms (solar system, whale or dinosaur) or too small organisms (microorganism) are hard to observe. Models are made to allow us get to know these too big or too small objects with more ease.

One of the key prerequisites for understanding work with models is abstraction of dimensions of the studied object – the pupil must be aware of the fact that a model of a cell is much larger than a real cell or that a model of an eye is much larger than a real eye. Optimally the pupil can represent the size of the real object.

### *3.2.4 Duration*


**Figure 9**: Representation of sound wave in the series Magic School Bus

Analogically also the time scale might be different in models of processes. The model may be faster (e.g. a model of soil erosion or a video of cell mitosis) or slower (e.g. a video of a running cheetah).

It is much harder to give pupils an idea of time duration of a process than of its dimensions. The progress of phenomena can be so fast or slow that a parallel imaginable to pupils does not exist. The figure shows an example from the series Magic School Bus where pupils observe propagation of sound waves using special glasses. In order to demonstrate that sound propagates as a wave, its movement is significantly slowed down while movement of people is not changed.

### *3.2.5 Models do not provide complex stimuli for sensory perception*

One must always bear in mind that when working with models pupils are deprived of a significant part of perception that they would experience if they were in contact with and manipulating real objects. A living animal unlike its model has a unique smell, is warm and soft when touched, makes sounds and pupils may observe signs of its life (growth, excretion, ingestion etc.). Although some advanced applications for iPads and iPhones can simulate some signs of life (e.g. growth), they can never simulate all of them.

**Example**

A six year old David answered the question: “What is nature?” as follows: “I think animals. On our tablet we have sheep, cows and maybe we will have a dog and a cat. We also have wheat there. It grows in 5 minutes.”

#### *3.2.6 Lack of variability*

A substantial disadvantage of models is their lack of variability. Models usually represent the typical situation. But variability is common in nature (e.g. fingerprints of every person are unique, there are no two identical leaves etc.). Teachers should work with variability but they very often try to avoid it.

**Example**

7$^{th}$ graders were asked to bring a tulip flower to a biology practicum. They were observing it, mounting it and recording its petal pattern. One of the pupils discovered her tulip had only five stamina (usually it is 6) and informed the teacher about this. The teacher accused the pupil of having bought this "defective flower" deliberately to spoil the practicum. The pupil was asked to record a standard tulip flower according to a drawing on the board in her worksheet. The teacher failed to use the potential of the situation and failed to work with variability.

### 3.3 How to bring models into lessons

Work with models of this category and the ability to make them and improve them is in fact the long-term didactical objective of science education. Naturally not everybody is able to achieve the level of work with models that represent theories, to create them and look for their shortcomings. The goal of science educators as well as developers of applications is to maintain the number of scientists who have actually acquired this ability (PISA reports are very critical and speak of a potential decline in the number of people who have this ability) or to increase it (Jančaříková, 2015).

When creating teaching materials one should be aware of the fact that models always represent only a part of reality. If they are to be used properly, pupils must be taught how to work with them and how to distinguish between a model and the object or the process it represents. When creating teaching materials, the following three principles should be respected.

#### *3.3.1 Proceed from simpler to more difficult*

Models must be included in lessons gradually, starting from simple models and moving to the more abstract ones. It helps if the first models represent objects that pupils are familiar with. The use of these models is not motivated by introducing the object to pupils but by the effort to introduce pupils to differences between models and reality.

The advantage of this approach is that pupils learn to work with models and gradually develop their competence for future work with models and for understanding even more complex and more abstract models.

#### *3.3.2 Showing the ratio*

If pupils are unaware of the differences between models and reality, teachers must pay attention to pointing out the differences between the depicted phenomena and reality. This puts high demands on the teacher. First of all, the teacher must understand what a model is, must be aware of the fact that a model is only an aid for description of reality (it is quite common that the teacher refers to the model of a cell as to a *cell*). The teacher should also know the level of their pupils' competence in work with models, should be able to estimate to what extent their pupils may grasp the new model. Also, the teacher must be able to assess how well their pupils cope with grasping the model.

#### *3.3.3 Example of good practice – Magic School Bus*

Ratio of dimensions is well shown in the series Magic School Bus. Dimensions are represented here by enlarging or making smaller the bus and subsequently comparing it to objects pupils are familiar with. In case the reduction exceeds pupils' imagination (e.g. to the level of cell), it is done in several steps.

#### *3.3.4 Problematic work with size of the model*

Work with the size of a model can become rather problematic in case of some applications that use augmented reality. The size of the depicted object in relation to real life objects depends on the user and does not have to correspond to reality. For this reason we do not consider use of these applications with very young learners as didactically correct.

**Figure 10**: Magic School Bus – Observing ants

**Figure 11**: Becky 3D Stereo Card

### 3.4 Computers and models

Thanks to the Internet and computer, documentaries and educational programmes about natural sciences are available to pupils without any limits. Thus pupils can observe behaviour of species in the wild that they would never meet under different circumstances. However, these observations can never fully replace direct contact with wildlife and nature. Children nowadays show symptoms of alienation from nature. That is why science education must include also activities in which children get the chance to build relationship to wildlife, to use all senses, i.e. also touch, smell and hearing. This is something that computer models still fail to provide.

Use of a model is not only in the hands of the author but also of the educator who works with it. A model is a model and cannot be taken as reality. However, developers of applications try to use names that evoke the idea that the applications present real animals, plants, nature. That can be very confusing, especially for young learners.

**Example**

The name of an interactive education application Real Animals HD designed for preschool and primary school children which is expected to help them learn about animals, their behaviour and habits is misleading. The fact is that the application does not show real animals even though the animals can move, jump or roll. The program depicts a flying elephant as an extreme case. However, there are many other situations in which it is hard to say whether the authors' intention was to show real behaviour of animals or whether it was meant to be an exaggeration.

## 4. Conclusion

Development in natural sciences resulted in a situation when pupils come across computer simulations of organisms and their parts or processes that take place in them more and more often. This puts new demands already on very young learners. They must have the specific skill of abstraction and the ability to understand the relationship between the (most often virtually presented) model and reality.

Not enough attention has been paid to work with models in science education (not only in the Czech Republic). There is no thorough methodology of work with models and it is not included in pre-service teacher training deliberately.

The situation in which pupils and students are subjected to two dimensional models or objects in e-learning without actually seeing it with their own eyes needs consistent preparatory work with models of objects the learner are familiar with, can view and touch. The same must be done when preparing learners for work with three dimensional projections.

Undoubtedly a lot of attention will have to be paid to work with models. The ability to work with models has grown indispensable and its importance keeps growing. The goal of this paper is to start an expert debate on this issue.

An extensive area that needs further research and that has great potential for school practice is the area of interactive computer models that connect descriptive knowledge of studied objects to their activity and functions by placing them into larger contexts. 3D technologies, including augmented reality (e.g. 3D anatomic atlases), have significant potential in the field of education. This means the question of how to use these technologies efficiently remains topical.

## Acknowledgements

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# Digital Learners in Higher Education: Exploring Technology Ownership Patterns and Learning Engagement

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**Abstract:** Recent studies into *'digital learners'* have pointed to the high level of digital skills which many UK and US based students entering HE are now demonstrating (White & Beetham, 2013; Pew, 2013). However while students may display high levels of functional skill or competency in digital media this is often evidenced in a narrow corridor of involvement with social media and may not indicate a well-rounded digital identity. Using digital devices informally for leisure opportunities does not necessarily foster the digital literacies required to develop the critical thinking and learning skills of university graduates. This is in line with Beetham & Sharpe (2014) who suggest that: *'digital literacy looks beyond functional IT skills to describe a richer set of digital behaviours, practices and identities*.' This perspective of wide-ranging digital competency but indeterminate levels of digital literacy amongst undergraduates is explored through the outcomes of two recent surveys, one undertaken in Australia (2012-3) previously reported at the Ascilite conference (Jefferies,2013), and the other at a German university in 2013-2014 which is the focus of this paper. This paper examines the evidence for digital competency and literacy displayed by German university students in support of their studies. In a quantitative study using an online survey tool based on previously published and widely acknowledged metrics, students were asked about digital ownership and their technology use during their HE studies. The questions asked about their use of common hardware platforms and popular software. The outcomes from the German study and the earlier Australian study are considered in the context of recent research into *'digital learners'* in the UK. Overall, the students' use of technology for learning, whichever country they were studying in, tended to be personally focussed, lacking evidence of active contribution to producing and critically evaluating material. In short, their contribution to digital engagement could be termed as surprisingly passive and consumerist (cf. Cochrane and Antonczak, 2015) rather than a pro-active engagement.

**Keywords:** technology ownership for learning, technology in HE, digital engagement

## 1. Introduction

A number of recent studies (Caruso, J., & Salway, 2007; Dahlstrom, 2012, Jisc, 2013) which have focused on student technology ownership and use have primarily considered countries across the Anglophone world. These reports have highlighted the changing usage of technologies across tertiary education, as well as in the post-16 age group, to support student learning. This paper is the first in an anticipated series which will report on the use by German university students of a set of technologies used in tertiary institutions as previously proposed by ECAR (see Caruso & Salway, 2007) and which have been used to inform research into student technology ownership. The study described below explores the self-reported use of technology for learning and leisure by a large cohort of students (n= 275) in Business and Engineering disciplines at a German university and draws comparisons between technology used for tertiary education and other studies including research into their use in an Australian university context and in the UK.

Interest in developing digital literacy among the Higher Education (HE) population has grown in the past decade and has been the subject of multiple research projects globally. In Europe, Horizon 2020 funding has contributed to this (Horizon 2020, 2016) and in the UK, institutions involved in supporting learning across the Further Education (FE), HE and Adult and Community Learning Education sectors have been supported by national funding from Jisc between 2012 to 2016 (Beetham, 2016) to make the most of digital tools for supporting learning on and off-campus and through the Managed Learning Environments (MLE).

While it is generally acknowledged in English-speaking countries that there is a high expectation that students now entering HE are confident and competent users of technology, a recent report suggests a rather patchy picture of digital engagement and connectivity across Europe. The Survey of Schools ICT in Education 2013, produced by the European SchoolNet in partnership with the University of Liège in Belgium, featured results from the first Europe-wide survey since 2008 and offered a country by country review of access to technology for pupils. It showed mixed results for engagement with learning technologies in secondary schools. In that report there was insufficient data available from the UK and Germany and this paper therefore partially redresses the balance with regard to students' experiences embarking on a German university programme.

The underlying context for the current study is the growing availability and embedding of MLEs across Higher Education Institutions (HEIs) which has developed alongside the growth in blended, online and distance learning in HE. The growth and use of MLEs in the USA, Australia and the UK is seen in the wide availability and relative affordability of personal technology for participants in the tertiary education group. The research motivation that lies at the heart of this study is to understand what technologies students have access to and own, and from the wide range available to determine what is important to them for supporting their studies and to develop a deeper digital literacy to enhance their use of technology across their studies. The study revealed a blurred division between those technologies and software which may be used solely for study and those which students use personally for connecting with family and friends through social media and for their leisure activities.

## 2. Background to personal technology use by students in the UK and Germany

Technology has become a ubiquitous part of daily life for both learning and leisure for many people, evidenced in the UK where in 2015 95% of adults owned a mobile phone, as reported by OfCom (2015), and ownership of smartphones, which have only generally been available since 2010 had grown to 70%. Tablet computer ownership in this report was estimated at 57% of the adult population (OfCom, 2015) and laptop ownership at 65% of adults. Broadband is now accessible in 80% of households and digital TV ownership is present in around 96% of households. It is beyond doubt that there has been a steep increase in accessing the internet through personal mobile devices in the past decade.

Germany now reportedly has the largest mobile subscriber base in Europe, with about 107 million subscribers and a penetration rate of around 130 percent, (Research and markets.com, 2013). With a well-advanced digital telephony, broadband in the home is widely available there.

## 3. Methodology for the German study

An online survey was drawn up and made available via its url to undergraduate students at a German university of applied sciences. The survey was hosted on a secure server in the UK. The original source of the questionnaire was the ECAR studies of HE student use of technology, with a small reduction in the types of technology included (Dahlstrom, 2012; Caruso & Salway, 2007).The content of the survey had previously been developed for a research study with undergraduates at an Australian university (Jefferies, 2013). The survey material has been used with university students based in the USA, on a regular basis and reported by Educause. Some items of technology were not considered relevant to this group of students and so were either omitted or clustered into small groups, for example the range of cameras and audio-visual equipment were reduced. The surveys were conducted within the ethics approval frameworks of the lead universities in each case.

Invitations to take part in the survey were sent to all students in the target groups of undergraduates by the research leader in Germany. After discussion it was agreed that the language used for the survey would be English as this would allow swifter comparison with comparative surveys and the intention was to have the outputs written in English. The students were deemed to possess a high level of written and spoken English understanding and the high completion rates indicated that the use of English in the questions was not a barrier to their participation.

The survey remained open for two months from September 2013 to the start of November 2013. Analysis was then undertaken using standard tools provided by the survey host and SPSS. Initially it had been planned to interview some of the students to gather some qualitative feedback but the students dispersed to placements and this became impossible to organise effectively.

## 4. Findings

The authors present their findings with a summary of figures indicating ownership of various items of hardware, the use of software for learning and leisure and subsequently the learning usage relations between leisure and learning usage of technologies drawn out from the analysis. Table 1 includes the full list of technologies that appeared in the survey.

### 4.1 Demographics

In terms of the demographics of the 275 participants in the study, 53% of the respondents were female and 47% of the respondents were male. 65% were aged 24 or under and 35% were aged 25 or over. 98% of the students identified as being Home students and resident in Germany and 96% identified German as their native language; other native languages stated included a variety of European languages. None of them identified as international students.

### 4.2 Technology ownership

It has already been noted above that Germany has a high level of mobile phone ownership and this was evident in their stated ownership of phones. However at 92% the reported ownership of phones was less than in the general population reported above. This was an unexpected outcome and it is inferred that some students may not have answered the questions on phone ownership. Overall analysis of their phone ownership however showed that students more often used their phones for supporting their learning than any of the other clusters of technology. At the time of the survey very few iPhones were owned or used, the most likely choice of phone was an Android type. The participants owned 190 smartphones, 116 of which were Android type and including 14 Blackberries. There was significant ownership of other non-smart mobile phones (n=62) but it was inconclusive how many students owned multiple phones as this question was not asked.

There was high ownership of audio devices by these students (74%), where audio comprised a cluster of iPod and mp3 players and similar. However there was low reported usage of their audio devices for supporting their learning. During a period of time where the use of podcasts to support learning has generally risen in the UK and Australia it was surprising to note that less than 9% of respondents indicated that they used their audio devices to support their learning. There was also high ownership of cameras and videos for leisure and general use but low reported use of these for supporting their learning.

Ownership of e-readers was 11% of students, with a third of these students also using them to support their learning. Now that personal e-readers have largely been replaced by e-reader apps such as Kindle, on phones and tablets, it is expected that e-reader ownership will diminish further since it demands the owner to carry an extra piece of equipment. However as can be seen in the list of software used by students noted below (Figure 1), the use of e-readers is around 30% and we assume this is due to the availability of e-reading software through library collections and embedded links to journal articles and other materials accessed from the MLE by the students.

Finally in this section on technology ownership we consider the ownership of handheld and stationary gaming devices. Handheld gaming devices were owned by 18% of students and stationary gaming devices such as X-Box or PlayStation were owned by 33% of students. This was lower than expected as figures for gaming device ownership across this generation of students and young adults in Western Europe and North America have shown the devices to be extremely popular. Games console ownership was at 55% among the 18-29 age range in the USA according to the Pew 2015 study.

**Table 1:** List of device ownership for student learning and /or leisure

| |
|---|
| iPhone |
| Android Phone (e.g. Droid, Galaxy, EVO,) |
| Windows OS Phone (e.g. HTC ) |
| Blackberry |
| Other smartphone |
| Other mobile phone |
| Digital point and shoot camera |
| Digital SLR camera |
| Digital Video camera |
| DVD Player |
| Blu-ray Player |
| HD TV/ set top box |
| 3D TV |
| Mp3 player/music device other than iPod |
| iPod |

| |
|---|
| Desktop Computer |
| Laptop Computer/Netbook |
| iPad |
| Other tablet (e.g. Galaxy Tab, Xoom) not iPad |
| E-reader (e.g. Kindle) |
| Webcam |
| USB thumb drive/portable hard drive |
| Handheld/portable gaming device (e.g. Sony PSP, Nintendo DS Lite) |
| Stationary gaming device (e.g. Xbox, Sony PlayStation) |

## 4.3 Student ownership of computers

Just 26% of students claimed to own a desktop computer but 30% indicated that they used desktop computers for supporting their learning. It is inferred from this that they either used a family computer or one at the university instead. Ownership of laptops and tablets together was 55%, so it is apparent that many students are using the computers provided at the university to complete their studies. Ownership of iPads included in the tablet figures above, was low at 6% overall. A figure of 81% ownership of computer or tablet or laptop is around the average of what might be expected for students in Higher Education, especially when considered alongside the figures above showing widespread ownership of mobile phones in Germany. According to figures from the Pew Research institute (PEW, 2015) ownership of desktop and laptop computers across the USA is 73% overall but at 78% for the 18-29 age range and overall ownership of mobile phones is comparable at 92%, with the statistics for phone ownership among these students.

Since student figures on which technologies they used for learning were higher than the ownership percentages, this would appear to confirm that they would expect to be accessing the university computers for completing their studies or possibly computers at home which were shared with other family members. The impact of the use of an MLE gauged from their software usage, would indicate that students were focusing their study time during the hours that the library and computer facilities were open and that 24 hour access to online materials was less of an issue for them compared with students studying purely at a distance.

Access to the more costly Apple products was less common than for the widely available and generally cheaper computers using Microsoft® software products. In the review of software discussed below it was clear that the MS Office® suite of programmes was widely used. Does the hardware lead to the software use or the other way round? Perhaps it is familiarity with the software and associated computers since their early school age which has driven the predominance of Microsoft® compatible machines among the students? Results from the 2015-16 study with a later cohort of German students will shortly be available and it will be interesting to note whether there has been an increase in the use of iPads in this German university to match the general growth in iPad use across the rest of Europe. Ownership of tablets was estimated to grow to 31.8 million in the UK during 2016 (EMarketer, 2016) of which nearly 60% would be iPads.

## 4.4 Student use of software for learning

In Figure 1 below we indicate the types of software accessed by students. It is clear that as mentioned above there is a dominance of MS Office® related products for managing course materials (word-processing, spreadsheets and presentation tools) and completing assessments. The use of Apps came as something of a surprise and at this stage without further investigation we take this to mean the use of mobile phone as well as tablet apps to support their learning. More recent versions of MS laptops with Windows 8 and later software encourage the sharing of Apps across multiple portable electronic devices. The use of more technical software tools for programming, graphics packages, simulations and LaTeX for document management is indicative of the type of courses that these Business and Engineering students are following.

With an increasing number of institutions requiring electronic submission of assessments in the future then the use of word processing, spreadsheets and presentation software is likely to increase further.

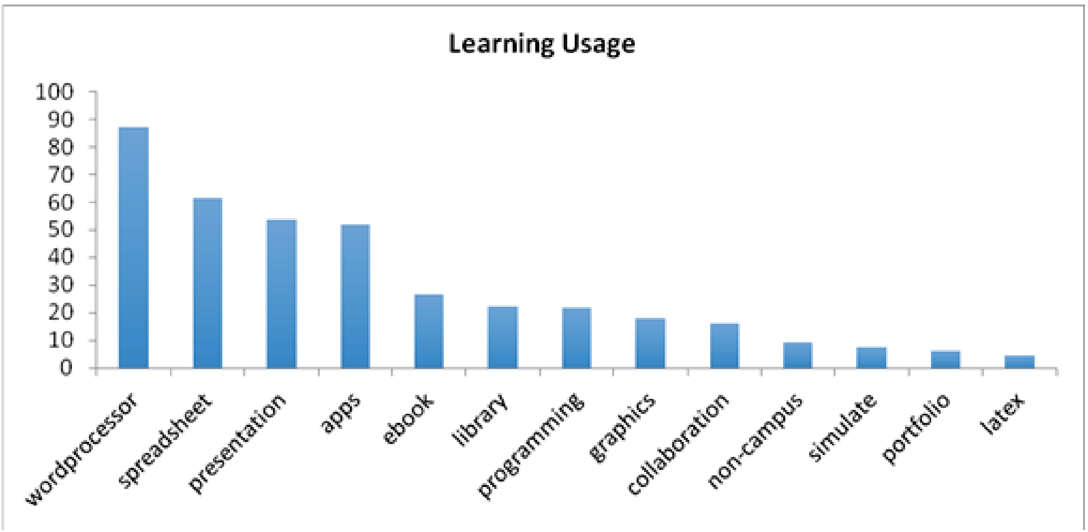


**Figure 1:** Percentage of students using different software tools for learning

### 4.5 Using technology to link learning and leisure

The research team considered to what extent students were using general software applications which crossed over from home and leisure use to their study time and back again. Figure 2 identifies the preferred software that they used regularly and at least weekly. It was no surprise to find that email, texting and instant messaging were all well used, the figures indicating overall technology use. In the details of the analysis 65% of students reported that they accessed instant messaging several times a day either via Facebook or texting. Overall 77% of participants were accessing their email at least once a day and 74% of students accessed Facebook at least once a day. Other social networking sites were largely spurned by the respondents as 69% of students did not access any others at all. Among technologies used in moderate proportions, skype, reading blogs, tagging materials for others and sharing photos and contributing to discussion fora showed around 30% usage by the students.

This is all much as would be expected and in line with research reported from multiple sources in the last several years. Of greater interest to the researchers were those applications which had a low level of engagement. Twitter clearly did not engage this group of students as just 5% used Twitter daily and 84% claimed never to use it. LinkedIn which is a business social media networking application similar to Facebook where business people can connect and promote their activities and profile was unused by 90% of participants. This came as a surprise since it had been expected that the students on Business courses would have been more likely to engage with this and to see LinkedIn as an important route for enhancing their future employability. Geotagging which has a niche social and leisure following was unused by 90% of the students.

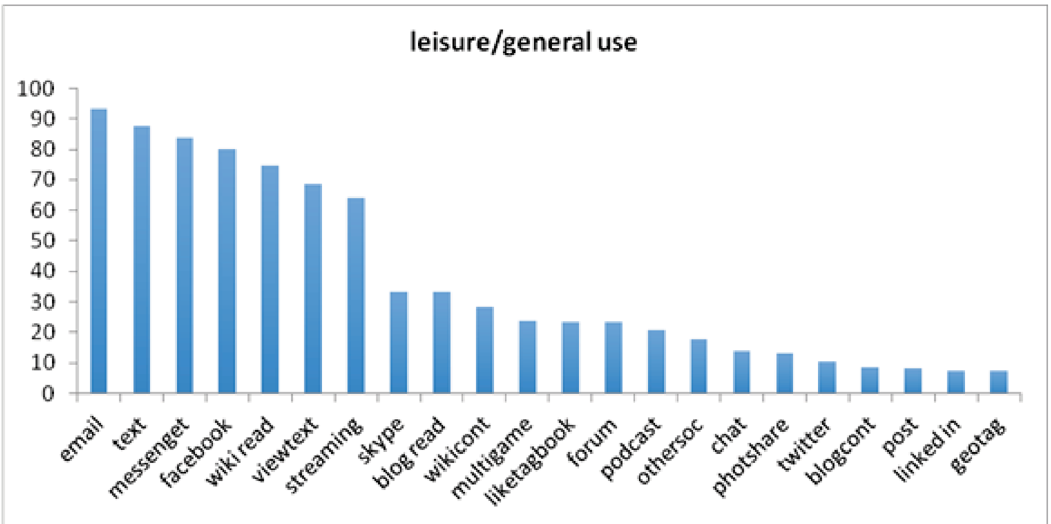


**Figure 2:** Percentage making frequent use of technology for leisure or general purposes

The students in this study showed many similar characteristics to those reported in earlier studies (see for example the literature reported in Jefferies (2015)), in terms of their use of online materials for viewing. There was a pattern of regular access to sites such as YouTube from which they could download or view audio and video material and visit blogs, forums, and podcasts for viewing materials. Far less evident was a willingness on the part of students to pro-actively post their own materials for sharing with others in the wider learning community. This was especially true in relation to sharing with those outside their immediate social group on Facebook or for other tasks including posting videos they had made for learning activities on YouTube, editing material on Wikipedia or contributing to blogs whether their own or others'. This passivity previously recognised in other studies (e.g. Cochrane & Antonczak, 2015; Beetham & Sharpe, 2014) and evidenced here will be discussed in more detail in the Conclusion.

## 5. The relationships between technology for learning usage and leisure/general usage

In analysing the data the researchers also used SPSS to identify if there were particular relationships across the software types used for learning when compared with the general and leisure usage.

27 relationships showed significance at a raw 5% level out of 182 possibilities and these are documented below. All were positive relationships indicating that higher leisure use of some applications by participants was associated with higher learning use in the particular relationships described.

More frequent podcast viewing (measured under the leisure and general use of software) was associated with more frequent learning use of: graphics software, e-portfolio use, simulation software use, spreadsheets, presentation and the use of apps.

More frequent skype viewing was associated with more frequent learning use of: presentation software, graphics software, spreadsheet and simulation software and word processing programmes, i.e. most of the suite of MSOffice® programmes.

More frequent blog reading was associated with more frequent overall learning use of programming and e-books. More frequent multi-person gaming activity was associated with more frequent learning use of the following: simulation software, programming and LaTeX use, i.e. this was drawing in the more technically minded students.

More frequent Twitter use (while at a low level overall) was associated with more frequent use of collaboration in learning, the first time that a positive link has reported between these two.

There were few statistically significant relationships identified between ownership and non-ownership of the technologies. The main contrast identified was between types of ownership. Learning ownership of hardware was positively associated with more learning use for some technologies, specifically phone ownership for learning was associated with collaboration, programming and app use. Ownership of audio devices showed a significant relationship with word processing and spreadsheets. Computer ownership showed a strong relationship with spreadsheets and apps.

In summary of the overall relationships between technology ownership and leisure use, some of these indicated a positive impact overall on usage for learning, and this is deemed more satisfactory than recording a negative impact.

## 6. Discussion

As mentioned in the abstract, this study set out to discover whether the undergraduate students at this German university might exhibit some of the characteristics of digital capability which have been raised by recent research. Beetham and Sharpe (2014) have previously reported on students in the UK exhibiting *'high levels of functional skill or competency in digital media …often evidenced in a narrow corridor of involvement with social media and may not indicate a well-rounded digital identity'*. This survey's findings also correlate with their research, in part.

The German students reported here were frequently accessing a variety of hardware and software technologies to support their learning, but they personally owned fewer items of technology on average than students reported in a recent small-scale Australian study (Jefferies, 2015). Some of the survey responses were surprisingly similar to those of the Australian students in terms of student usage of learning technologies. There was wide-ranging access to learning technologies but ownership was at a lower level in Germany. 100% of those responding to the ownership questions in Australia claimed to own a laptop computer or netbook. The pattern for software access was similar with frequent use made of the university MLE (Blackboard in this case) and high daily access of Facebook (74%) as their social media of preference. Students showed only occasional and sporadic use of Twitter (16%) and low levels of uploading their own self-generated material. While 62% downloaded YouTube videos at least weekly, less than 5% would post videos online; only 7.5% contributed to a blog weekly. Student technology use in the Australian study was thus reported as being primarily passive with very few indicating that they participated in sharing their own materials online and with an associated very low reported usage of Twitter, LinkedIn, and uploading of materials for the general community use to YouTube or discussion fora. These studies both accord with recent research reported in UK-based studies where students are perceived as being more conservative in their use of technology for leisure and learning than media reports had inferred (Jisc, 2016). Results from the German and Australian research studies indicate a similarity in HE students' ownership and usage of learning technologies as they develop greater personal digital literacy during their studies. Highly digitally competent students nevertheless appear unwilling and unpractised at critiquing material further or engaging in the critical evaluation suggested as a key skill above. This issue was identified among UK HE students by White and Beetham (2013:3), when they commented that: *'Students rarely use technology for advanced knowledge-related activities or problem-solving unless they have been required to do so by their course or tutor'.*

Students are freely pulling information down for personal use from their university's MLE and other media but there is no convincing evidence that they are '*producing, sharing and critically evaluating information'* (Jisc, 2013). Cochrane and Antonczak identified this same issue of passivity and selective use of social media outlined above in their own recent study of technology use among this generation of young adults.

> *'In contrast to the myth of the 'Digital Native' and the ubiquity of Facebook use, we have found that students' digital identities are predominantly social with their online activity beyond Facebook limited to being social media consumers rather than producers. (Cochrane & Antonczak, 2015)*

In related research the findings from the SchoolNet report (Wastiau et al, 2013), where widespread access to Information Communications Technology (ICT) was reported across various European countries, proposed among other issues that even where access to ICT is widely available, there was less evidence of deep digital confidence: 'There is no overall relationship between high levels of ICT provision and student and teacher *confidence, use and attitudes.'* (Trocano, 2013). The studies across tertiary level students have not measured the contribution of teachers and academics but staff engagement and its impact on student engagement with technology use for learning has been shown to be a significant contribution to greater student involvement and growing digital confidence by recent work from Jisc (Beetham, 2016).

## 7. Conclusion

Tertiary students in Germany, Australia, the US and the UK may demonstrate extensive ownership and use of personal technologies to support their learning with high levels of perceived competency. What steps should now be taken to develop their critical faculties and ensure high levels of digital literacy as they graduate and seek employment? How can we encourage a wider engagement with and contribution to communities of practice (Wenger, 1998) during their studies?

There is growing use of technology in schools in Europe and the UK and 70% of UK pupils now use tablets according to Pew (2014) but students apparently remain unprepared for the development of key digital literacy skills in universities. Multiple studies of developing digitally literate HE graduates indicate the need to move students on from a consumerist and passive culture described above to more pro-active engagement with digital media. The 'richer set of [collaborative] digital behaviours' identified by Beetham & Sharpe (2014) should be encouraged at all levels and by our universities. How might this be encouraged across HE practice in Germany, Australia and further afield?

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# Learning Personalisation Approach Based on Resource Description Framework

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**Abstract:** The paper is aimed to analyse the problem of learning personalisation applying Resource Description Framework (RDF) standard model. Research results are two-fold: first, the results of systematic literature review on RDF application in learning are presented, and, second, RDF-based learning personalisation approach is proposed. First of all, systematic literature review was conducted in Thomson Reuters Web of Science database and using Semantic Scholar search tool. The review has shown that RDF data model is based upon the idea of making statements about web resources in the form of subject–predicate–object expressions. These expressions are known as triples in RDF terminology. The subject denotes the resource, and the predicate denotes traits or aspects of the resource and expresses a relationship between the subject and the object. The review revealed that linked data and triples-based RDF standard model could be successfully used in education. On the other hand, although linked data approach and RDF standard model are already well-known in scientific literature, only few authors have analysed its application to personalise learning process, but many authors agree that linked data and RDF-based learning personalisation trends should be further analysed. Original RDF-based learning personalisation approach is also presented in the paper. According to this approach, RDF-based personalisation of learning should be based on applying students' learning styles and intelligent technologies. The main advantages of this approach are analyses of interconnections between students' learning styles and suitable learning components (i.e. learning resources, learning methods and activities, learning tools and technologies etc.) based on using pedagogically sound vocabularies of learning components, experts' collective intelligence, and intelligent technologies (e.g. expert evaluation, ontologies, recommender systems, software agents etc.). This pedagogically sound RDF-based personalisation approach is aimed at improving learning quality and effectiveness.

**Keywords**: learning personalisation, resource description framework, linked data, learning styles, intelligent technologies

## 1. Introduction

Personalised learning and application of Semantic Web and other intelligent technologies in education are important research areas of modern educational technology. Therefore, in recent years, researchers were extremely interested in such personalisation strategies (Ignatova et al, 2015; Kurilovas et al, 2015) and Semantic Web and other intelligent technologies (Troussas et al, 2014, Bobed et al, 2014; Ermilov et al, 2014). According to Kurilovas et al (2014), there has not been a concrete definition of personalisation so far. The main idea is to reach an abstract common goal: to provide users with what they want or need without expecting them to ask for it explicitly.

The aim of the paper is to analyse the problem of learning personalisation applying Resource Description Framework (RDF) standard model. The results of the performed systematic review on RDF and semantic description in learning and personalisation are discussed, and an original learning personalisation framework addressing student's learning styles and based on RDF and intelligent technologies is presented.

The rest of the paper is organised into following sections. Systematic literature review on RDF in learning, semantic description of learning resources and learning personalisation is presented in Section 2. Section 3 is aimed to discuss findings of the systematic review. Section 4 presents an original approach to personalise learning using RDF and other intelligent technologies. Section 5 concludes the paper.

## 2. Systematic review

In order to identify scientific methods and possible results on RDF application to personalise learning, systematic literature review method devised by Kitchenham (2004) has been used. The main goal of the systematic review was to find out the state-of-the art strategies and semantic web approaches to personalise learning by identification suitable learning objects (LOs) for student in conformity with his/her learning styles.

The following research questions have been raised to perform systematic literature review:

- What semantic web strategies and approaches are used to semantically describe and retrieve learning resources?
- How Semantic Web technologies, like RDF, can be used to support learning personalisation?

Systematic literature review was performed on March 18, and updated on May 12, 2016. In order to get a wider view on semantic web technologies that can be used for our goal formulated above, we did not include "learning styles" into search keywords. The search was undertaken in Thomson Reuters Web of Science database and then using Semantic Scholar tool (https://www.semanticscholar.org/). Search protocol in Thomson Reuters Web of Science is presented in Figure 1.


**Figure 1**: Search history in Thomson Reuters Web of Science database

We searched for the papers published during the last years (2013–2016). Topic *(metadata AND learning AND resource* AND semantic*)* was selected in order to address our research question 1. According to it, 32 papers were found, including 16 articles. Topic *(RDF AND learning)* addressed research question 2, and there were 72 results found for this query, including 29 articles. Topic *(RDF AND personalization)* was selected in order to find out the answer to research question 2 as well, and according to it, 7 papers, including 3 articles were found.

Additional search was conducted using Semantic Scholar tool. For the same period (2013–2016), there were 10 papers found using the key phrase *metadata for learning resources*. The results for the key phrase *RDF AND learning* gave a considerable amount of unrelated to the topic results (about 1500–2000 papers per year). The related results coincided with those found in the Web of Science database.

After applying Kitchenham (2004) systematic review methodology, on the last stage 19 suitable papers were selected to further detailed analysis (17 coming from the Thomson Reuters Web of Science database, and 2 unique papers from the Semantic Scholar). The analysis results are as follows.

Over time, several competing metadata standards and educational metadata schemas have been proposed, e.g. the widely adopted IEEE LOM (Learning Object Metadata), ISO/IEC MLR – ISO 197884 (Metadata for Learning Resources – MLR), Dublin Core, IMS etc. However, the adoption of a sole metadata schema is usually not sufficient to efficiently characterize learning resources. A number of taxonomies, vocabularies, and application profiles (AP) are defined to address this problem. Repositories also exploit diverse interface mechanisms such as OAI-PMH or SQI (Dietze et al, 2013). Gabor et al (2013) state that existing metadata standards (LOM and similar) lack educational feature descriptions about educational needs, especially if we deal with multimedia LO. Therefore, according to Gabor et al (2013), metadata are usually augmented with additional information by application of semantic web approaches. Navarro et al (2013) argue that certain complex LOs need to be complemented with different types of domain-dependent information for their pedagogical planning and retrieval. The authors propose a theoretical approach that permits to dynamically change domain-dependent information schemas and use a single LO repository for classifying and enriching learning. The approach is based on a meta-relational model for the dynamic definition of specific domain-dependent relational database schemas used for classifying and enriching LOs.

A number of studies discuss metadata usage in conjunction with ontologies to ensure effectiveness in LO description, search, and retrieval. For instance, Solomou, Pierrakeas and Kameas (2015) present an ontology model for the developed IEEE LOM educational AP with enhanced technological and educational fields, aimed to improve the discovery and retrieval of LOs within intelligent e-learning systems. The authors develop a personalised learning system that uses this educational AP and its ontological representation in order to offer advanced services to students. Huang et al (2013) present an approach of the construction of knowledge retrieval and navigation system, based on ontology-based knowledge organization model for learning resources. The knowledge organization model includes the parts of subject domain ontology, metadata extraction, and automatic classification for LOs. In this model, the metadata of LOs are semantically described basing on the domain ontology, and in this way the knowledge organization and navigation for learning resources is implemented.

The design of recommender systems is an ongoing research area where intelligence is incorporated into web content systems to be able to provide recommendations to students on the basis of their learning preferences, i.e. based on their learning profiles (Sunil and Saini, 2013). The authors discuss the design of a recommender system based on ontology, mapped to the learning content, and learner profiles created in the system. In order to provide support for personalised access to the resources that exist in open educational repositories, Almudena et al (2014) propose the recommendation strategy combining a description of the LOs based on metadata standards enriched by ontology-based semantic indexing, and contextual information about the user.

Resource Description Framework (RDF) proves to be a widely used semantic web framework to solve the problems we address in this paper. The Semantic Web is a collection of components working together so that a machine is able to process and understand information. In order for this vision to be implemented, formal standards for representing and interpreting data are used, including the RDF and machine processable ontologies (Algosaibi and Melton, 2014). RDF as a recommended format for representing data is one of the most important contributions to the semantic web concept. It brings opportunity to develop new approaches to data analysis. The main idea is to represent each piece of data as a triple: "subject-proposition-object", where the "subject" is an entity being described, "object" is and entity that describes the subject, and the "proposition" is a connection (a relation) between subject and object. A subject of one triple can be an object of another triple, and vice versa. This gives a network of interconnected triples by Chen and Reformat (2014). RDF data can be analysed with various query languages, e.g. SPARQL.

Chen (2015) proposes an approach to transform metadata from equivalent lexical element mapping into semantic mapping with contextual relationships, based on RDF. RDF is used as a crosswalk model to represent the contextual relationships implicitly embedded between described objects and their elements. The semantic, hierarchical, granular, syntactic and multiple object relationships are included to achieve semantic metadata interoperability at the data element level. RDF-based expressions let manifest into a semantic representation the sets of shared terms, contextual relationships between described objects and their metadata elements. The author has developed nine types of mapping rules to achieve a semantic metadata crosswalk.

By combining semantic descriptions already lying or implicit within the descriptive metadata, reasoning-based or semantic searching of these collections can be enabled and produce additional possibilities for content browsing and retrieval (Solomou and Koutsomitropoulos, 2015). The authors employ semantic searching techniques on digital repositories and introduce a methodology to pragmatically evaluate and get measurable results of the semantic searching in such scenarios. Chen and Reformat (2014) suggest building categories based on similarity of entities contained in the data to provide more benefits in addition to properties indicating data type and subject, provided in RDF-based data.

There is a wide variety of technologies available to deal with exposing, sharing and integrating educational web data, but according to the number of publications in recent years, it can be stated that Linked Data based approaches have gained a lot of attention and started realising the vision of highly accessible and web-wide reusable learning resources by providing the standards, tools, and Web infrastructure to expose and interlink educational data at web-scale (Dietze et al, 2013).

Semantic Web technologies and Linked Data are changing the way information is stored, described and exploited (Chicaiza et al, 2014). The "Linked Data" term refers to a set of best practices for publishing and connecting structured data on the Web. Chicaiza et al (2014) deal with improvement of the associations between learning subjects, areas and topics, including semantic relations and recommendations about resources for learners. The advantages of linked data web are used to support semi-automatic classification of educational resources. The relations of the resources are encoded in RDF language and stored in the repository, a query language is used to retrieve data, and the knowledge of organizational systems and linked data is used to classify the web resources according to the domain.

The survey presented in (Dietze et al, 2013) is one of the first comprehensive surveys on the topic of Linked Data for education and provide an extensive overview of the Linked Data approaches for technology-enhanced learning. It aims to provide rich and well-interlinked data for the educational domain, using the existing technology-enhanced learning data on the web by allowing its exposure as linked data, and using automated enrichment and interlinking techniques.

New opportunities for relating learning resources identified by URIs combined with the usage of RDF as a lingua franca for describing them are arising with the emergence of web of data (Rajabi et al, 2015). The authors present an approach for exposing existing IEEE LOM metadata as Linked Data. IEEE LOM elements (simple and structured, as well as with multiplicity) are transformed into XML representation and RDF triples (subject, predicate and object). The metadata are linked to the datasets in LOD (Linking Open Data), e.g. DBPedia. A case study and a reference implementation along with an evaluation have proved the concept of this mapping. Selected queries passed a performance testing on both relational database and triple store.

Vert and Andone (2014) suggest using Linked Data principles to discover, integrate and reuse online learning resources, using standards and principles proven to foster web interoperability, like RDF and SPARQL. The authors concentrate on the solutions for open educational resources. The publishing of resources as Linked Data is done in several steps: selection of data sources, usage of vocabularies and ontologies to model the data, conversion to the RDF data model, including cleaning of the data, publishing the semantic-enriched data to linked learning resources repositories and consuming the data, usually through SPARQL endpoints.

Dessi and Atzori (2016) address the problem of ranking among properties of the entities used in RDF datasets, Linked Data and SPARQL endpoints. The authors provide applications for property tagging and entity visualisation, and propose to apply Machine Learning to Rank techniques to the problem of ranking RDF properties. The major advantages of the approach are: flexibility/personalisation, speed, effectiveness.

Linking Open Data (LOD) cloud is a collection of linked RDF data with over 31 billion RDF triples. Accessing linked data is a challenging task due to ontology schema specifics in each data set (Zhao and Ichise, 2013). To solve this issue, the authors propose an automatic method to integrate different ontology schemas: Mid-Ontology learning approach that can automatically construct an ontology, linking related ontology predicates (class or property) in different data sets. The approach consists of three main phases: data collection, predicate grouping, and Mid-Ontology construction. Experiments show that our Mid-Ontology learning approach successfully integrates diverse ontology schema, and effectively retrieves related information.

Chung and Kim (2015) design an ontological semantic model of achievement standards (the standards, providing guidelines about what has to be taught and assessed by teachers and what has to be studied and achieved by students). Mapping rules are defined to formalize the semantic model to RDF/OWL specification. The approach is based on Linking Open Data. The proposed semantic model is used to create linked data profile searching and browsing, sharing, modification history tracing, learning resource linking.

While personalisation, adaptation and recommendation are central features of web-based educational environments, recommender systems apply information retrieval techniques to filter and deliver learning resources according to user preferences and requirements (Taibi et al, 2013). The authors state that, however, the suitability of possible recommendations is fundamentally dependent on the available data, i.e. metadata about learning resources and data about the users. To solve the limitation in quantity and quality of both types of data, the Linked Data movement has become very active over the recent years. Taibi et al (2013) propose a large-scale educational dataset, generated by exploiting Linked Data methods and applying clustering and interlinking techniques to extract, import and interlink a wide range of educationally relevant data.

Research work, presented in (Morshed et al, 2013) is aimed to develop knowledge recommendation system for the Linking Open Data Cloud using semantic machine learning approach. Knowledge is stored in a triplestore using RDF triples format (subject, predicate, and object) along with the complete metadata. The authors argue that such a RDF representation made the developed intelligent knowledge base very flexible to integrate with the Linking Open Data cloud.

## 3. Findings of the systematic review

The review has shown that many authors agree that "pure" metadata approaches to describe learning objects lack flexibility to address the issues of personalisation. RDF provides facilities for data merging even if the underlying schemas differ. RDF data model is based upon the idea of making statements about web resources (LOs) in the form of subject–predicate–object expressions. RDF extends the linking structure of the resources to use URIs to name the relationship between "subject" and "object" as well as the two ends of the link (this is referred to as a "triple"). The "subject" denotes the resource, and the "predicate" denotes traits or aspects of the resource and expresses a relationship between the "subject" and the "object".

The review has also revealed that linked data and triple-based RDF standard model could be successfully used in education. Although Linked Data approach and RDF standard model are already well-known in scientific literature, only few authors have analysed its application to personalise learning process. Thus, Almudena et al (2014) propose the recommendation strategy combining a description of the LOs based on metadata standards enriched by ontology-based semantic indexing, and contextual information about the user. According to Taibi et al (2013), the suitability of possible recommendations is fundamentally dependent on the available metadata about LOs and data about the users. Solomou, Pierrakeas and Kameas (2015) develop a personalised learning system that uses IEEE LOM educational AP and its ontological representation in order to offer advanced services to students.

On the other hand, many authors agree that linked data and RDF-based learning personalisation trends should be further analysed.

## 4. Learning personalisation approach based on RDF and intelligent technologies

The authors' personalisation approach is based on Kurilovas et al (2014) and Kurilovas (2015). According to this approach, RDF-based personalisation of learning should be based on applying students' learning styles and intelligent technologies. The main advantages of this approach are analyses of interlinks between students' learning styles and suitable learning components (i.e. LOs, learning methods and activities, learning tools and technologies etc.) based on using pedagogically sound vocabularies of learning components, experts' collective intelligence, and intelligent technologies (e.g. expert evaluation, ontologies, recommender systems, software agents etc.).

According to this approach, RDF triples should interlink (1) LOs ("subject") including metadata, (2) contextual information about particular learner ("object"), and (3) suitable learning methods, activities and tools ("predicate"). In this RDF triple, the "subject" denotes the resource, and the "predicate" denotes traits or aspects of the resource and expresses a relationship between the subject and the object.

According to Kurilovas (2015), implementation of this approach consists of the following stages:

- Creating learners' dynamic profiles/models according to their learning styles and other features.
- Creating interlinks and ontologies to establish suitability of learning components to particular students' learning styles.
- Creating recommender system to recommend suitable learning components to particular students.

Thus, creating interlinks and ontologies to establish suitability of LOs, learning methods/activities, and learning tools/environments represent the following stage after creating students' profiles.

In Kurilovas et al (2014), personalisation is analysed in terms of suitability of LOs, teaching/learning methods and learning activities to particular learning styles according to Honey and Mumford (2000) learning styles model. Analysis of interrelations between learning styles, learning activities, teaching methods, and LOs types is presented in Kurilovas et al (2014) based on expert evaluation of learning components' suitability to learning styles. After that, an example of interlinks between teaching/learning methods (M) and learning resource types (T) for problem-solving learning activity was presented in Figure 1:

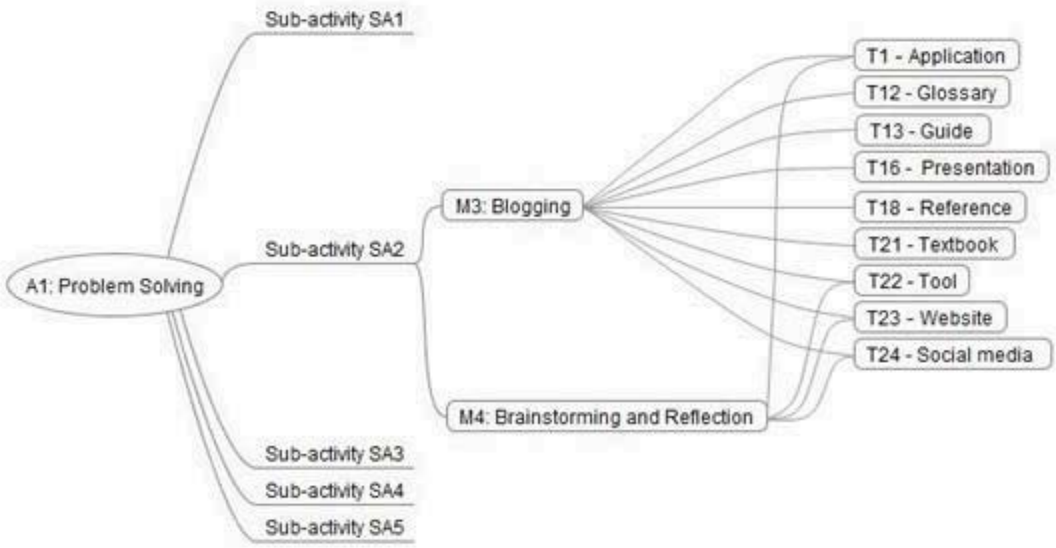


**Figure 1:** Example of interlinks between teaching/learning methods and LOs types for problem-solving learning activity (according to Kurilovas et al (2014, p 660))

Further on, ontology example is presented in Kurilovas et al (2014). This ontology presents a query for finding suitable learning activities by methods (i.e. "Problem Solving" activity could be found using "Blogging" teaching/learning method).

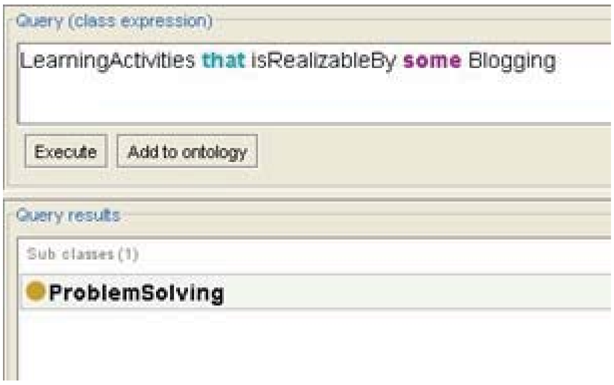


**Figure 2:** Query for finding suitable learning activities by methods (according to Kurilovas et al (2014, p 660))

In Kurilovas et al (2014), the authors have analysed only "Learning Resource Type" LOs metadata field. These interlinks could be enriched by analysing several additional fields of LOs metadata according to IEEE LOM standard such as "Structure", "Format", "Interactivity Type", and "Interactivity Level" (Dorça et al, 2016).

According to Kurilovas (2015), after interlinking and ontologies creation stage, recommender system should be created to link students' personal data in their profiles, relevant LOs according to corresponding metadata fields, and learning activities and tools suitable to particular students according to their learning styles and other profiles' data.

Interlinking and ontologies creation should be based on the expert evaluation results. Experienced experts should evaluate suitability of learning components (LOs, learning activities and tools) to particular students' needs, e.g. learning styles. The higher suitability ratings the better learning components fit the needs of particular learners. Pedagogically sound vocabularies of learning components should be applied at this stage.

An example of the method to create personalised recommender system was presented in Juškevičienė and Kurilovas (2014). The prototype of recommender system has been developed following the working principles of the knowledge-based recommender system. The domain knowledge was conceptualised in the ontology.

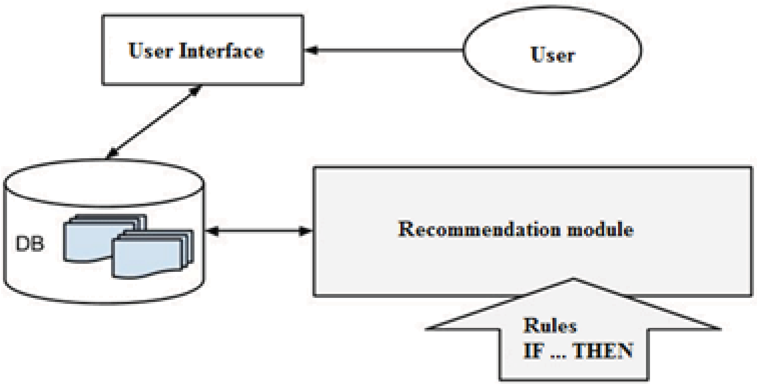


**Figure 3.** Scheme of the recommender system (according to Juškevičienė and Kurilovas (2014, p 26))

Recommender system should form the preference lists of the learning components according to the expert evaluation results of suitability of learning components and students' data e.g. learning styles. Probabilistic suitability indexes should be identified for all learning components in terms of their suitability level to particular learners. Thus, personalised learning packages/scenarios could be created for particular learners using suitable learning components. A number of intelligent technologies should be applied to implement this approach, e.g. ontologies, recommender systems, intelligent agents, personal learning environments etc.

## 5. Conclusion

The systematic review presented in the paper has shown that RDF data model is based upon the idea of making statements about web resources in the form of subject–predicate–object expressions (RDF triples). The subject denotes the resource, and the predicate denotes traits or aspects of the resource and expresses a relationship between the subject and the object. The review revealed that linked data and triples-based RDF standard model could be used in education. On the other hand, although linked data approach and RDF standard model are already well-known in scientific literature, only few authors have analysed its application to personalise the learning process, but many authors agree that linked data and RDF-based learning personalisation trends should be further analysed.

Original RDF-based learning personalisation approach is presented in the paper. According to this approach, RDF-based personalisation of learning should be based on applying students' learning styles and intelligent technologies. The main advantages of this approach are analysis of interlinks between students' learning needs e.g. learning styles and suitable learning components (i.e. learning objects, learning methods/activities, learning tools/technologies etc.) based on using pedagogically sound vocabularies of learning components, experts' collective intelligence to evaluate suitability of learning components to particular learners' needs, and application of intelligent technologies (e.g. expert evaluation, ontologies, recommender systems, software agents etc.). This pedagogically sound RDF-based personalisation approach is aimed at improving learning quality and effectiveness. The learning package (scenario, unit) of the highest quality for particular student means a methodological sequence of learning components with the highest Suitability Indexes. The level of students' competences, i.e. knowledge/understanding, skills and attitudes/values directly depends on the level of application of high-quality learning packages in real pedagogical practice.

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# The Impact of Lecture Capture on Staff's Teaching Practice in a UK University

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**Abstract**: Lecture capturing is rapidly being deployed in Higher Education Institutions (HEIs) as a means of increasing student learning, experience and inclusivity. As research begins to accumulate on the effectiveness of Lecture Capture (LC) in HEIs, it appears that LC is largely beneficial to students' learning and their academic performance. It is less clear, however, how the use of LC has impacted on lecturers' own teaching practice, as studies that explore this issue have only begun to surface fairly recently. Has the use of LC impacted on lecturers' design and delivery of learning activities and programme of study? Has it influenced their ways of giving student feedback and support? Does it have any impact on their knowledge and professional values? Understanding how staff use these systems to develop their own practice is an issue that has largely been unexplored but it is important to enhance reflexive teaching. This study aims to provide a deeper understanding of the impact of LC on staff's teaching practice, through a web survey of academics (n46) in an English University. The descriptive statistics revealed the use of LC impacting four areas of teaching activity (delivery of lectures and supporting learning; assessment and feedback related activities; developing effective learning environment and their approach to student support and guidance; engaging in their continuous professional development and their approach to incorporation of research and evaluation of their practice) as well as their core knowledge and commitment to professional values. Relatively less impact on the area of designing and planning learning sessions was reported. It is concluded that there is strong evidence to indicate that the LC has impacted academics' core knowledge, their commitment to professional values and certain teaching practices. The findings have important practical implications, as they provide HEIs with a new set of evidence to build a convincing case for implementation, promotion, and sustained use of LC as tool to enhance teaching practice.

**Keywords**: lecture capture, teaching practice, higher education, learning technology, UK professional standards framework

## 1. Introduction

The aim of this research is to understand the impact of Lecture Capture (LC) on staff's teaching practice in an English university. Lecture capture is often used as an umbrella term describing a range of technologies used to digitally record and distribute lectures to students (Price and Almpanis, 2015). Although historically the term was used to describe various ad hoc methods for recording a session, recent technological developments have automated the whole process of recording audio and the teacher's screen, and optionally input from a camera, and making it available to students rapidly after the session. At the University where this research has taken place, the lecture capture system (Panopto) has been used in a number of ways that include, but are not limited to, recording live sessions so that students can review them at a later time, creating audio-visual materials outside the classroom to enhance students' learning, recording students' presentations and recording students' formative role-playing activities.

In recent years, there has been a considerable increase in the use of LC in the Higher Education Institutions (HEIs) in the UK. There are several studies that examine the impact of LC on learner-related issues such as students' attitudes to lecturing, in-class behaviour, attendance rates, academic performance and outcomes and a few on lecturers' attitudes towards and concerns about LC implementation in a given context (see Whitthaus and Robinson, 2015 for a full review). However, relatively little research has studied the possible impact of LC on staff's own teaching practice. Understanding the extent of possible influence of LC on teaching practice, from the perspective the very users of LC, is critical to enhancing lecturers' own experience of teaching and students' experience of learning in a given context. This research addresses this gap by investigating staffs' perceptions on LC's impact on their practice of teaching. Our research question is *how does Lecture Capture impact Staff's teaching practice, if at all, in a university?*

Understanding *Impact & Teaching Practice*

Impact in this study was understood as the extent to which academics believed that the use of LC has influenced them to undertake all tasks related to their teaching, to the best of their ability, in a given context. This influence could be a benefit, enhancement of their practice, or a change in any direction, in short-, medium- or long term basis. Thus, impact, in this study includes all types of influence the use of LC has on staff's teaching practice (i.e. positive and negative, intended and unintended outcomes, related to staff's knowledge, values and teaching practices, experienced subjectively or collectively, with a passage of time).

Similarly, teaching practice is also understood in this study, very broadly. Considerable effort has been spent on understanding teaching and teaching practice in the field of higher education research (see for full review, Tight 2012). Studies (e.g. Prosser, Trigwell & Taylor 1994, Korhonen, Weil 2015) have consistently established that there are discernible variations in how teaching has been understood by university academics. Hence, in the interest of relying on a framework that is credited with a significant professional consensus on what HE teaching is, we have decided to adopt in this study, the UK Professional Standards Framework (UKPSF) for teaching and supporting learning in higher education and this is identified as a "nationally-recognised framework for benchmarking success within HE teaching and learning support" (Higher Education Academy 2011). It includes a set of descriptors for five areas of professional teaching practice, namely, 1) Design and plan learning activities and/or programmes of study, 2) Teach and/or support learning, 3) Assess and give feedback to learners, 4) Develop effective environments and approaches to student support and guidance and 5) Engage in CPD in subject disciplines and their pedagogy, incorporating research, scholarship and the evaluation of professional practices. It also specifies *core knowledge* needed for teachers, and *professional values* that they should exemplify. In this study, teaching practice is understood to include all of the above areas, core knowledge and professional values. In essence, the study aims to understand how the use of LC has impacted the five areas of activities, their core knowledge and commitment to professional values, as enshrined in the UKPSF. While the impact of LC in areas 1, 2 or 4 of the UKPSF may be somewhat evident in earlier studies, LC's impact in all areas of the framework has not been addressed explicitly and systematically before, and in this way our study contributes to extending our knowledge on the impact of LC.

The paper is structured as follows. We establish the empirical context of LC research and highlight the distinctive focus of this research. Then, we briefly describe our survey instrument, before presenting analytical findings and the discussion of implications. Overall, we provide empirical evidence in support of LC's impact on university staff's knowledge, commitment to values and certain teaching practices.

## 2. Literature review

The level of adoption of lecture capture within UK HEIs has been significantly increasing over recent years. The UCISA survey carried out in 2012 on the use of Technology Enhanced Learning (TEL) by HEIs indicated that 50% provided a lecture capture as a core service (Walker, Voce & Ahmed 2012). The subsequent 2014 USCIA survey found this had changed to 63% (Walker et al, 2014), the pace of adoption is likely to have increased even more over the past two years.

A majority of recent research on LC focuses on the issue of its impact on student performance and learning outcomes. Some scholars have found a positive impact on student grades (Hove et al 2008, Traphagan et al 2009, Terry et al 2015), others find little or no impact *(*Bollmeier et al 2010, Franklin et al 2011, Leadbeater et al 2013, Hadgu et al 2016) and some others report potential negative side effects (Williams et al 2010, Johnston et al 2013). Within the literature a large number of studies highlight the strength of student perceptions that LC supports their learning and outcomes (Owston et al 2011, Johnston et al 2013, Danielson et al 2013, Marchand et al 2014, Price & Almpanis, 2015).

A key concern raised by the academic community is that the introduction of recorded lectures will have a negative impact on levels of students' attendance (Traphagan et al 2009, Leadbeater et al 2013). A number of literature reviews have considered the findings of recent studies (Mahal 2012, Pursel 2012, Karnard 2013, Whitthaus and Robinson, 2015) to evaluate any associated drop in attendance. In a review of 47 articles Pursel & Fang (2012) found 26 studies which specifically addressed attendance, reporting that the majority found no negative impact, although acknowledging some did find a correlation between LC usage and lower attendance figures. It appears that this inconclusive areas is continue to be of a concern to many researchers.

When compared to the numerous studies that looked at LC's impact on student outcomes and perceptions, research concerning its impact on teaching practice is sparse. According to a recent report (Witthaus and Robinson 2015), the main change in teaching practice reported in the literature as a result of the introduction of LC was the 'flipped classroom', a practice where the lecture can be recorded and delivered prior to the session during which the time can be used for discussion and group work. These studies have usefully indicated the LC's potential to influence teaching practice in more ways than it is currently understood. A comprehensive understanding of possible influence of LC on teaching practice is important for improving teaching and learning in HE. This research addresses this gap by focusing on the very users of LC and the possible impact they might have because of LC usage. In the next section, we explain our web survey methodology.

## 3. Research method

The setting for this study is a university in south of England, which has adopted LC as a core service, following a pilot programme. The recorder software (*Panopto*) has been installed on workstations in every teaching space and is available for academics to download and install elsewhere. An opt-in system was used to create the pool of trained lectures. In the first year of a managed roll out, 121 staff have used LC as part of their practice, mostly using audio alongside screen capture recordings of lectures. Since September 2015 over 3000 sessions have been recorded (2,172 hours). This setting offered an ideal opportunity for us to explore the connections between the use of LC and their teaching practice. We utilised a 51 items questionnaire as a data collection tool. It had number of statements, ranging from 3 to 13 for each section, grouped under the five areas of activity, core knowledge and professional values, as specified in the UKPSF. Each statement had options for respondents to rate them on a 5-point Likert scale, ranging from 'Strongly Disagree' to 'Strongly Agree'. On gaining necessary approvals, a pilot study was conducted with five expert lecturers, who use LC more frequently, "to eliminate problems of wording, length or approaches" (Krenzke, Van de Kerckhove & Westat 2005, p. 3259). Based on the findings of the pilot study, minor refinements were made to distinguish foci of certain questions. Then, in accordance with the good practice principles, described in Fan and Yan (2010) and Couper (2008, 2001), the questionnaire was designed as a web survey. All 121 staff have been provided with a link to the web survey. In order to reduce non-response bias, small incentives were provided and two email reminders were sent.

## 4. Data analysis and findings

A total of 46 staff from across the university completed the survey and returned online, yielding a response rate of 38%, with 57% (n26) of are male and 43% (n20) female. The study's general findings are grouped under seven topics and the descriptive statistics from the survey are shown in the tables 1 to 7. The values presented will be approximate percentages and might not necessarily equal 100%. To further aid understanding, we provided an illustrative comment under each section, both to serve as an empirical evidence to our claim and to represent respondents' own voice.

### 4.1 The impact of LC on DPL dimension ('Design and Plan Learning activities and/or programmes of study')

Seven questions were used to capture LC's impact on DPL (see Table 1). Most lecturers believed that LC has not impacted the design of lectures (59%), and their planning of lectures (60%). Similarly, more academics believed that their selection of learning objectives and activities (74% and 55% respectively) and the ways they structure their class time (54%) have not been influenced by LC. These results may relate to the ways the respondents tend to use LC in this context, as there is variation in ways LC was used, as 53% (n24) used it to record a session only in the classroom, and 9% (n4) using outside the classroom, and 33% (n15) using a mixture of both the options. Training staff to use LC in more creative ways might increase these results. Overall, it can be concluded that LC has been used to support current practice, as almost half of them (46%) agree that LC has facilitated their use of additional learning resources, and relatively less to designing and planning learning sessions:

> *"I have thought about this carefully and do not feel that using LC has altered the way I approach my planning and structuring of lectures".*

### 4.2 The impact of LC on TSL dimension ('teach and/or support of study')

Thirteen questions were used to understand LC's impact on TSL (see Table 2). Considerably, more lecturers are of the opinion that LC has not impacted on the ways they have changed their course delivery style (45%); use of examples and content materials (56% and 54% respectively); and it has not limited their use of humour (80%). LC appears to be less intrusive and restrictive. The use of LC, however, has played a facilitative role as more lecturers believed that LC has impacted on, the ways they have modified their teaching style (48%); their use of active-learning techniques (45%); their ability to accommodate diverse needs (80% and 71% respectively); the awareness of inclusiveness (69%) and their knowledge of individual needs (48%). Overall, more of the lecturers surveyed both agreed/strongly agreed (44%) that LC did impact on their TSL. It can be concluded that by influencing their teaching style, particularly by making them aware of the need to be inclusive, by enabling them to accommodate diverse needs of students, and by not restricting their use of humour, LC did influence the staff.

> *"I am much more conscious of my speed of delivery, choice of language, diction and the tying together of visual and audio information when using lecture capture."*

> *"I am more aware of the international students and because of LC, I have slowed down my lecturing speed. I encourage students to go back play my lectures. Thus, it gave me greater freedom, although I had been more self-conscious when I started using it."*

### 4.3 The impact of LC on AFL dimension ('*assess and give feedback to learners')*

Three questions captured an understanding of the AFL (see Table 3). Most of the lecturers surveyed have the opinion that LC had enhanced their teaching based on student feedback (55%) and peer observations (74%). A third of them (39%) agree that LC has impact on their practice of giving feedback to students. On average, 56% believed that LC had impacted on their AFL, and therefore, we can conclude that overall, there is considerable impact on staff's ability to assess and give feedback to learners:

> *"It has been brilliant for providing more detailed feedback to the students and strengthening our relationship with our externals who can see the assessment in full."*

> *"I regularly ask all my colleagues to review my performance on delivering through LC. This is a norm that I have introduced."*

### 4.4 The impact of LC on DEL dimension ('develop effective environments & approaches to student support and guidance')

With respect to DEL, nine questions were used to measure an understanding of this area of activity (see Table 4). Almost half of the lecturers (45%) believe that LC has enhanced the ways they design their visual learning aids.

> *"I no longer have to run as many individual tutorials to support students in their work. I now use video plenaries to give students support in their assignments rather than having to run and repeat the plenary in seminars over and over again...."*

However, in relation to the lecturers' physical movement and classroom layout, 54% also believed it had not impacted on the ways they move around the classroom during teaching and 71% disagreed that LC has impacted on the ways they manage their classroom layout. The data also suggests that although lecturers' *attitudes* towards providing support and guidance have not been influenced by the use of LC, their way of providing student's support, and guidance, have been influenced by LC (54% and 37%). It appears that LC has more influence on task behaviour than on attitudes of student guidance and support. Interestingly, 22% of the respondents said that LC had reduced students' expectations of after-lecture one-to-one support, probably students knew that they can listen to the lectures later and thereby enabling lecturers to move between classes quickly or to focus on things that are equally important after their classes. Interestingly, 44% of the lecturers are uncertain whether it reduced student expectations regarding after-lecture support. It is possible that these respondents may never thought of this metric as one that can be used for understanding LC's impact; or their use of LC may be restricted to some teaching related tasks ("I only use LC for assessment"). Raising awareness about these indicators may alter this score. Significantly, 52% of the respondents agreed or strongly agreed that the use of LC has influenced the way they use their Virtual Learning Environment (VLE). It is logical to assume that these respondents may have linked their recorded lectures on subject-specific, student's learning portal pages and thus their use of VLE has been increased. Overall, our data suggests that the impact of the use of LC has been experienced relatively less in lecturers' physical movement in the classroom, and in ways classroom are laid out. However, lecturers' ways of designing visual learning aids, of providing student and support, and their use of VLE have been influenced by the use of LC.

> *"It has cut down on the number of students who would have come to ask me for clarification of something covered in class".*

### 4.5 The impact of LC on ECP dimension ('engage in CPD in subject disciplines and their pedagogy, incorporating research, scholarship and the evaluation of professional practices')

For the ECP, seven questions were used to measure an understanding of this area of activity (see Table 5) Responses from all the questions showed that a considerable number of lecturers believed that LC had impacted on their continued professional development (80%), and to incorporate research into teaching, to reflect on and to evaluate their practices (58%, 85% and 80% respectively). Considering the high scores across this important area of activity, LC's impact on teaching practice appear to be significant in making lecturers' more reflective and self-evaluating. In relation to promoting peer-evaluation, 69% of the lecturers are of the opinion that LC has enabled comprehensive feedback from their peers and it has increased their teaching ability, and adaptability to evaluations of teaching practice (48% and 41% respectively). In conjunction with the score of an earlier statement on LC's potential to giving peer feedback (in Table 3, statement 3), where 74% who agreed or strongly agreed), it appears that LC has a huge potential to promote peer feedback. On average, most lecturers (60%) both agreed/strongly agreed that LC had indeed impacted on area of activity.

> *"It made me think of what I am doing in the class room. Very few of my peers have actually listened to my lectures, but something needs to be done."*

### 4.6 The impact of LC on core knowledge (CK)

An understanding of the impact of LC on Core Knowledge (CK) was made possible with six questions (see Table 6). Most of the lecturers surveyed believed that LC has impacted on their awareness of appropriate methods and values of teaching and technology (54%, 82%, and 84%). 76% also believed that LC has made them aware of the quality of their teaching. A reduced number (44%) believed that by their use of LC, they are now more aware of the ways their students learn, as they may have already known about the various ways students learn and LC did not add to that awareness. Similarly, 61% both agreed/strongly agreed that the use of LC has contributed to enhancing knowledge of their subject material. A respondent provides a possible reason for this high score:

> *"I don't think LC can contribute to enhancing knowledge in a subject or the nuts and bolts of good teaching"..."My research informs my teaching. LC in itself provides no new knowledge."*

In relation to the use and value of appropriate learning technology, a vast majority of them have reported that the use of LC has enabled them to learn about both the use of (82%) and the value of (84%) an appropriate learning technology. LC's impact on this area of core knowledge is noteworthy. Likewise, a majority of them (76%) have agreed or strongly agreed that LC has enabled them to be more aware of the quality of their own teaching. Considering the importance of reflexivity for transformation of practice (Grace et al 2006), LC's contribution in this area appears to be highly significant. Overall, although respondents' core knowledge of the subject they teach is not impacted, the use of LC has impacted on their knowledge of teaching methods of their subject, their ability to learn about the use and value of appropriate learning technology, while enabling them to be aware of the quality of their own teaching.

### 4.7 The impact of LC on commitment to professional values (PV)

Six questions were used to measure an understanding of the PV concept (see Table 7). 47% of the lecturers felt that LC has helped their ability to have more respect for individual learners. More so, is the fact that 57% believed that their use of LC has helped their knowledge of the diverse learning communities while 67% believed it has helped them to promote equality of learning opportunities amongst learners. 48% of the respondents also felt that LC has increased the awareness of their professional practice. A very negligible difference exists with respect to the impact of LC on the wider education context in which lecturers operate. Overall, 47% believed that LC has impacted on all dimensions of their PV. This is another significant finding of this study revealing LC's impact on the staff's commitment to professional values:

> *"I do think it is a tool that improves inclusivity because of the diverse student cohort and in the absence of these and lecture notes, you need to rely on students' notes. We cannot make them take notes. There may be some who may not even know how to take notes. LC helps with this".*
> *In summary, our analysis of survey data reveals that the use of LC has impacted staff's teaching practice in complex ways and there is variation in the reported impact on their practice. The study concludes that staff's core knowledge, their professional values, and certain teaching practices, including their ways of teaching and supporting learners, assessing and giving feedback, providing*

*student support and guidance, engaging in CPD and self-evaluation have been significantly improved or changed for the better, by the use of LC. There is relatively less change in design and planning learning area of professional dimension as the use of LC tends to support existing practice. In other words, the use of LC has noticeable positive influence on most dimensions of UKPSF and lecturers' core knowledge and professional values. In the following, some implications of these findings are discussed.*

## 5. Discussion and conclusions

This paper focuses on an important, but often-overlooked dimension of Lecture Capture effectiveness research - its impact on staff's teaching practice. Addressing this research gap, this study analysed staff's perceptions of LC's impact through an online survey. Using a sample of 46 university staff, we found support for a varied level of impact. Overall, the results collectively indicate that the use of LC has significantly impacted most dimensions of staff's teaching practice, as defined in the UKPSF. The results indicate that the respondents have changed or enhanced their ways of delivering learning sessions, of providing support and guidance, of engaging with their CPD and as a result, becoming more reflective in their practice, and of evaluating their practice. Importantly, some elements of core knowledge and commitment to most of the professional values tend be impacted upon by the use of LC, in that they became more inclusive, more aware of the diverse needs of learners, and more knowledgeable about the use and value of appropriate learning technology. Thus, our study has provided an expanded evidence of how LC impact looks like in reality, from the perspective of the users of LC. With so many of our respondents' professional practice being impacted on by the use of Lecture Capture so instinctively, we believe that LC can help transform teaching and learning in HE institutions in subtle ways, by making academics more reflexive and self evaluating practitioners. The relatively smaller size of sample and the possible non-response bias may be a limitation. To reduce the possible limitations of this mono-method study, conducted in a particular point of time, we are interviewing a representative sample of expert LC users to capture different dimensions of the same phenomenon. Our semi-structured interviews might further reveal respondents' personal stories in complementing and clarifying the quantitative results in the paper, their causal descriptions of how and why the use of LC has impacted their practice, and whether or not disciplinary differences in ways the respondents experience the reported impact of LC. In a forthcoming mixed method paper, we hope to provide more convincing evidence, additional confirmation of findings, increased validity and an enhanced understanding of the impact reported here. In sum, by focusing its effort to recognising the centrality of lecturers' own practice, in the context of too many student-focused studies within LC-related research, this study has provided a new set of evidence for LC impact. This knowledge can help make a convincing case for implementation, promotion, and sustained use of LC in many HE institutions.

**Table 1**: Responses of the questionnaire of LC and DPL

| Table 1 Responses of the questionnaire of LC and DPL* | | | | | |
|---|---|---|---|---|---|
| | | Design and Planning Activities | | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| I have changed the way I design my lectures | 4% | 24% | 13% | 57% | 2% |
| I have changed the way I plan for my lectures | 5% | 24% | 11% | 58% | 2% |
| I have changed the way I set learning objectives for my lectures | 0% | 11% | 15% | 67% | 7% |
| I have changed the way I select learning activities | 9% | 27% | 9% | 50% | 5% |
| I have changed the way I structure my class time | 9% | 28% | 9% | 52% | 2% |
| I have made changes in the way I use additional learning resources (e.g handouts) | 13% | 33% | 11% | 36% | 7% |
| | | | | | |
| Average | 7% | 25% | 11% | 53% | 4% |
| DPL: Design and plan learning activities and or programmes of study | | | | | |

**Table 2**: Responses of the questionnaire of LC and TSL

| Table 2 Responses of the questionnaire of LC and TSL* | | | | | |
|---|---|---|---|---|---|
| | | | Teach and/or Support Learning | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| I have changed the speed of my teaching delivery | 2% | 33% | 20% | 43% | 2% |
| I have made changes in the way I use language | 9% | 33% | 9% | 47% | 2% |
| I have increased the number of examples I use in my lectures | 0% | 22% | 22% | 53% | 2% |
| I provide additional explanations during my lectures | 7% | 34% | 20% | 34% | 5% |
| LC has limited the use of irrelevant content when delivering my lectures | 2% | 18% | 26% | 41% | 13% |
| LC has limited the use of humour in my lectures | 5% | 4% | 11% | 60% | 20% |
| LC has developed my ability to find new ways of stimulating students' interest in the subject matter | 2% | 36% | 31% | 27% | 4% |
| LC has helped me modify my style of teaching | 5% | 43% | 18% | 34% | 0% |
| LC has improved my use of active-learning techniques | 4% | 41% | 20% | 33% | 2% |
| LC has improved my ability to accommodate the diverse needs of students in my classroom | 38% | 42% | 11% | 9% | 0% |
| LC has improved my ability to accommodate the diverse nature of international students in my classroom | 31% | 40% | 20% | 7% | 2% |
| LC has improved my ability to be inclusive in my teaching delivery | 31% | 38% | 20% | 9% | 2% |
| LC has improved my awareness of the individual needs of the students in my classroom | 17% | 31% | 26% | 24% | 2% |
| | | | | | |
| Average | 12% | 32% | 20% | 32% | 4% |
| TSL: Teach and or support of study | | | | | |

**Table 3**: Responses of the questionnaire of LC and AFL

| Table 3 Responses of the questionnaire of LC and AFL* | | | | | |
|---|---|---|---|---|---|
| | | | Assess and Feedback | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| Based on students' feedback on LC recordings, I have enhanced my teaching practice | 9% | 46% | 28% | 15% | 2% |
| LC has impacted the way I provide feedback to my students | 9% | 30% | 25% | 34% | 2% |
| I believe that LC would be useful for giving feedback to my colleagues (e.g. peer observation scheme) | 28% | 46% | 22% | 0% | 4% |
| | | | | | |
| Average | 15% | 41% | 25% | 16% | 3% |
| AFL: Assess and give feedback to leaners | | | | | |

**Table 4**: Responses of the questionnaire of LC and DEL

| Table 4 Responses of the questionnaire of LC and DEL* | | | | | |
|---|---|---|---|---|---|
| | | | Develop Effective Learning | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| LC has influenced my classroom layout | 0% | 9% | 20% | 56% | 15% |
| LC has influenced the way I move around in the classroom | 4% | 29% | 13% | 47% | 7% |
| LC has influenced the way I design my visual learning aids | 7% | 38% | 22% | 33% | 0% |
| LC has influenced my attitude towards providing student support | 7% | 29% | 22% | 40% | 2% |
| LC has influenced my attitude towards providing student guidance | 9% | 24% | 27% | 38% | 2% |
| LC has influenced the way I provide support to my students | 17% | 37% | 11% | 35% | 0% |
| Because of the use of LC, I have changed the way I guide my students | 4% | 33% | 26% | 33% | 4% |
| LC has reduced students' expectations of after-lecture one-to-one support | 2% | 20% | 44% | 30% | 4% |
| LC has influenced the way I use the Virtual Learning Environment (myCourse VLE) | 11% | 41% | 20% | 28% | 0% |
| | | | | | |
| Average | 7% | 29% | 23% | 38% | 4% |
| *DEL: Develop effective learning environments and approaches to student support and guidance | | | | | |

**Table 5**: Responses of the questionnaire of LC and ECP

| Table 5 Responses of the questionnaire of LC and ECP* | | | | | |
|---|---|---|---|---|---|
| | | | Engage/Professional Development | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| The use of LC has contributed to my continuing professional development | 11% | 69% | 11% | 7% | 2% |
| has helped me incorporate research into my teaching | 2% | 17% | 41% | 33% | 7% |
| LC has helped me reflect more on my teaching practices | 13% | 72% | 4% | 9% | 2% |
| LC has helped me evaluate my own teaching practice | 17% | 63% | 7% | 11% | 2% |
| I believe that LC has the potential to enable me to get more comprehensive feedback from my peers | 18% | 51% | 20% | 11% | 0% |
| LC has increased confidence in my teaching ability | 7% | 41% | 24% | 24% | 4% |
| By using LC, I have become more open to accept others' evaluation of my teaching practices | 4% | 37% | 33% | 24% | 2% |
| | | | | | |
| Average | 10% | 50% | 20% | 17% | 3% |
| *ECP: Engage in continuing professional development in subjects disciplines and their pedagogy, incorporating research, scholarship and the evaluation of professional practices | | | | | |

**Table 6:** Responses of the questionnaire of LC and CK

| Table 6 Responses of the questionnaire of LC and CK* | | | | | |
|---|---|---|---|---|---|
| | | | Core Knowledge | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| The use of LC has contributed to enhancing my knowledge in my subject material | 6% | 9% | 24% | 54% | 7% |
| The use of LC has made me more aware of appropriate methods of teaching my subject | 4% | 50% | 22% | 20% | 4% |
| The use of LC has made me more aware of the ways students learn | 2% | 42% | 25% | 29% | 2% |
| LC has enabled me to learn about the use of an appropriate learning technology | 22% | 60% | 9% | 7% | 2% |
| LC has enabled me to learn about the value of appropriate learning technology | 20% | 64% | 9% | 5% | 2% |
| LC has enabled me to be more aware of the quality of my own teaching | 9% | 67% | 13% | 9% | 2% |
| | | | | | |
| Average | 11% | 49% | 17% | 21% | 3% |
| *CK: Core knowledge – the subject material; appropriate methods of teaching, learning and assessing in the subject area and at the level of the academic programme; how students learn, both generally and within their subject/disciplinary areas(s); the use and value of appropriate learning technologies; methods for the evaluating the effectiveness of teaching; the implications of quality assurance and quality enhancement for academic and professional practice with a particular focus on teaching | | | | | |

**Table 7:** Responses of the questionnaire of LC and PV

| Table 7 Responses of the questionnaire of LC and PV* | | | | | |
|---|---|---|---|---|---|
| | | | Professional Values | | |
| | Strongly agree | Agree | Uncertain | Disagree | Strongly disagree |
| The use of LC has helped me respect individual learners more | 5% | 42% | 29% | 20% | 4% |
| The use of LC has helped me respect diverse learning communities | 5% | 52% | 20% | 18% | 5% |
| The use of LC has helped me promote student participation in lectures | 2% | 28% | 39% | 28% | 2% |
| The use of LC has helped me promote equality of opportunity for learners in my lectures | 5% | 62% | 20% | 9% | 4% |
| The use of LC has increased my awareness of the wider higher education context in which I operate | 2% | 30% | 33% | 33% | 2% |
| The use of LC has increased my awareness of the possible implications of my professional practice | 9% | 39% | 37% | 15% | 0% |
| | | | | | |
| Average | 5% | 42% | 30% | 21% | 3% |
| *PV: Professional values – respect individual learners and diverse learning communities; promote participation in higher education and equality of opportunity for learners; use evidence-informed approaches and the outcomes from research, scholarship and continuing professional development; acknowledging the wider context in which higher education operates recognising the implications for professional practice | | | | | |

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# Instruction Outside the Classroom: Mobile, or Ubiquitous Learning?

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**Abstract:** The paper describes the design of a coherence model of instruction, which aims at a better understanding of curriculum in context and knowledge retention in long-term memory. The coherence model is built on four pillars: cooperative learning, activating teaching methods, instruction in authentic environment, or more precisely in educational expositions and spatial learning strategies. These strategies use a nonlinear representation of knowledge, such as dynamic semantic networks. Based on the principles of a coherence model of instruction an educational application for tablets was designed, developed and evaluated. This application serves as a virtual guide through the Ostrava Zoo and contains the following features: navigating through an educational exposition, multimedia and interactive information board, visualization of dynamic semantic networks, electronic worksheets and continuous testing of the pupil´s contextual understanding of the actual curriculum. The evaluation of the coherence model of instruction and the virtual guide was carried out by three methods: observing the pupils´ behaviour and work, a pedagogical experiment and evaluation questionnaires. This paper presents the results of the third method, evaluation questionnaire. One of the conclusions suggests that mobile technologies and mobile learning are not yet a completely ideal medium of instruction in outdoor educational expositions. These deficiencies can be partially overcome by specialized static devices installed directly at the place of the individual educational activities, wearable technology, the Internet of things, devices for augmented or virtual reality and finally ubiquitous learning.

**Keywords:** mobile learning, museum education, spatial learning strategies, ubiquitous learning

## 1. Introduction

The advent of new technologies is always accompanied by the desire to use these technologies to improve education and to increase pupils´ motivation for learning – radio, television, computers, internet or social media are just a few examples of these technologies. Currently, it is ubiquitous technologies, such as mobile and wearable technology and the Internet of things (Kinshuk and Huang, 2015). In the example described in this paper, mobile technologies are used as a supporting tool for achieving the educational goal stated below.

The scope and objective of teaching in schools should not only be mechanical, mindless memorization of individual facts without context. On the contrary, it is desirable that the pupil should truly understand the curriculum and after analysing a problem, be able to synthesize the individual findings as well as be able to use the gained knowledge in practice. True understanding, when a pupil is able to organize the learned single items into a network of semantic relationships, also represents a way to retention in long-term memory and practical application of those items. But how to achieve this?

As a solution, a coherence model of instruction which aims to achieve coherence of knowledge about single facts through a network of semantic relationships has been designed (Kapoun, 2016). Based on the principles of the coherence model a virtual guide through educational expositions was developed. This educational application uses a combination of linear and nonlinear representation of curriculum, in this case, dynamic semantic networks.

The paper presents one part of the research (evaluation questionnaire) which was carried out under the project called "Virtual guide through educational expositions" (Kapoun, 2016). The purpose of the project was to design, implement and evaluate a model of instruction, methodology and an educational application using media, information and communication technologies (MICT).

*Note: Introduction of the MICT concept – the commonly used term ICT was extended by the media attribute for the following reasons:*

- print or broadcast mass media can also be used in instruction;
- with the advent of digital television and radio broadcasting there is a convergence of mass media and information and communication technologies;
- the information technologies themselves are media, because they mediate knowledge;

- educational expositions and individual exhibits are also media.

The educational application (virtual guide through educational expositions) was developed for tablets.

## 2. Specification of terms

*eLearning*

The concept of eLearning is seen as a broad platform for education. Although used often, the concept is very broad and its boundaries are blurred. Sometimes it is used as a synonym for distance learning and is put into contrast with “face-to-face” education. Even the term “blended learning” is sometimes explained as blending “face-to-face” instruction and eLearning. Blended learning in a planned, systematic and pedagogically valuable method that integrates electronic and online instructional methods with direct (personal, non-media) classroom activities. Blended learning uses information and communication technologies not as an isolated supplement, but as a fully integrated part of instruction. The intention is not only to eliminate the disadvantages of both methods of instruction but to achieve a synergic effect (Picciano, 2009).

This paper understands eLearning as an educational process, using ICT to create courses, to distribute learning content, to facilitate communication between pupils and teachers and to manage learning.

Emphasis is placed on the didactic aspect, where eLearning means joining instructional system design (ISD) with a suitable model of instruction in the ICT environment. Greater weight is placed on *learning*, while the prefix *e-* informs about using ICT tools (Zlámalová, 2008).

*Note: After all, distance learning can take place without ICT, e.g., courses organized by the Open University in the 90's of the last century, and conversely, education with ICT support may take place in face-to-face instruction, such as in primary schools.*

*Mobile learning*

Similarly, ambivalent is another frequent concept – *mobile learning* (Crompton, 2013). One interpretation claims that mobile learning is actually eLearning operated with mobile technologies. Below are several reasons why such an interpretation is not suitable. Mobile learning is a qualitatively and methodologically different way of teaching compared to “classic” eLearning, it is a peculiar category in both teaching and learning (Kapoun and Milková, 2014).

- Mobile devices have smaller touchscreens and touch control, therefore have a different way of displaying and interaction which requires a different way of presenting and working with educational content.
- Compared to traditional computers, mobile devices carry other features and functions, such as wider range of connectivity options, the possibility of taking pictures and videos, GPS navigation, a compass, an accelerometer, a barometer, connection to external sensors or the use of augmented reality.
- Mobile devices offer new opportunities for learning outside of school. Because they are truly personal tools, mobile devices enable continuous creation of personal learning environments (PLE).
- Schools have to count on the trend called Bring Your Own Device (BOYD). Currently, pupils come to classroom and work with school computers that have more or less the same operational system and applications. However, a pupil can bring her/his own mobile device and wants to connect to the school network and utilize and share various documents and applications, in other words to work in the school cloud.
- Mobile devices allow for better use of a broader portfolio of teaching methods and group forms of instruction than eLearning. Included among these forms and methods are: tours in museums, field work, research activities, educational games in nature, learning through real-life situations and group or cooperative learning.
- From the pupil´s point of view the most important factor is that smartphones and tablets are very popular. This high popularity of mobile devices among children means that the very use of their devices in education can be a powerful motivational factor. It does make a difference to the pupils whether they get the same information or educational content from a textbook or from a tablet.

On the one hand the paper deals with the issue of using MICT in primary school (eLearning in face-to-face instruction) and on the other hand with the issue of using mobile technologies in instruction in outdoor educational expositions.

*Ubiquitous technology, computing and learning*

Ubiquitous computing can be considered as a new hype in the information and communication world. The ubiquitous technology involves a large number of small electronic and communication devices such as smartphones, wearable technology, the Internet of things, contactless smart cards or RFID (Radio Frequency Identification), which are used in everyday life. These small computers are equipped with sensors and actuators, which allows them to interact with their environment. These new technologies are supposed that teaching methods are evolving from eLearning through mobile learning (mLearning) to the current ubiquitous learning (uLearning).

> *Ubiquitous learning, also known as u-learning, is based on ubiquitous technology. The most significant role of ubiquitous computing technology in u-learning is to construct a ubiquitous learning environment, which enables anyone to learn at anyplace at anytime. Nonetheless, the definition and characteristic of u-learning is still unclear and being debated by the research community. (Yahya, et al., 2010)*

We are witnesses of a massive boom of new technologies (wearable technology, the Internet of things, augmented and virtual reality) on markets nowadays. We can expect that producers of these ubiquitous technologies want to place their products at schools. Educational institutions should be prepared in advance if they do not want to ask: we have the futuristic technology, but what to do with it now?

## 3. Introduction to the issue

To achieve better coherence and consistency of the pupils´ acquired knowledge and skills a design of a coherence model of instruction was created. Based on this model a general methodology was created and using this methodology, an educational application utilizing MICT was developed.

*Spatial learning strategies*

The theoretical starting point in finding ways for pupils to develop understanding in context and achieve long-term curriculum retention, are *spatial learning strategies* (Kapoun, 2015). These strategies use a nonlinear representation of knowledge, i.e., the curriculum. The underlying principle for various approaches in this area is a two-dimensional visualization of the subject matter structure and relationships between concepts. Spatial learning strategies build on the assumption that pupil first has to "organize everything in his/her own head", that is to consciously construct and reconstruct the network of concepts and relationships in his/her *n*-dimensional long-term memory (Mašek and Zikmundová, 2010). Besides extended concept mapping (Lăcrămioara, 2015), there are other methods of nonlinear knowledge representation, for example hypertext, structuring key concepts, recurrent graphic organizing and also semantic networks (Lukasová, et al. 2010). When designing the virtual guide through educational expositions (educational application for mobile devices) a set of dynamic semantic networks was created. The content of these networks is the intersection of school´s curriculum on one hand and the offering (exhibits and various activities) of the educational exposition in the other. Figure 1 shows a simplified version of such a semantic network. The dashed edges indicate assertion antecedent (if antelope eats grass) and full edges assertion consequent (then antelopes are among herbivores). The AKO relationship indicates that an object "is a kind of".

For better use of the educational potential of semantic networks it is suggested that these networks are dynamic. Specifically, it means:

- dynamic semantic networks are multimedia, animated and interactive;
- dynamic semantic networks are generated in real time according to the course of instruction.

Dynamic semantic networks are used for four purposes:

- for the preparation of instruction, educational activities, and expositions;
- for optimal paths through the educational process, such as eLearning courses or educational expositions;

- for representation of knowledge, respectively curriculum;
- for testing of knowledge using semi-blind semantic networks.

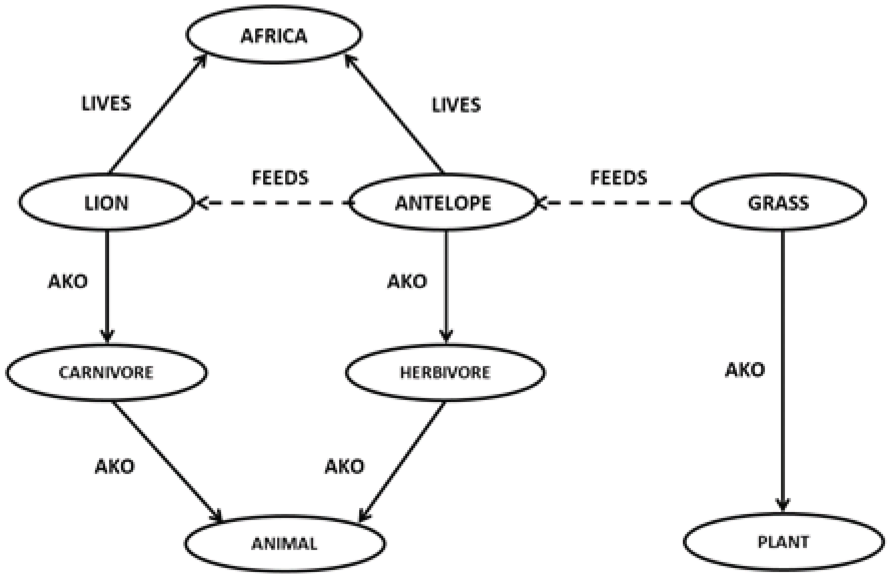


**Figure 1:** Semantic network representing objects and relationships in zoology

Dynamic semantic networks cannot be presented in textbooks or other printed materials because they include multimedia, animated and interactive objects. Their presentation and usage in education require the deployment of ICT.

## 4. The virtual guide

Testing the suitability and efficiency of the coherence model of instruction was carried out by evaluating experimental instruction with the support of the virtual guide through an educational exposition. The guide was created on the basis of the proposed model and the methodology derived from the model. The experimental instruction happened in cooperation with the Ostrava Zoo. The zoo was chosen because in zoology there are number of structured systems (ecological links, food chain, taxonomic system, etc.), which are suitable for nonlinear representation by dynamic semantic networks.

The virtual guide through educational expositions is not only an educational application on mobile devices, but also performs other functions:

- a navigator through an educational exposition;
- multimedia and interactive information board;
- visualization of dynamic semantic networks;
- electronic worksheets;
- continuous testing of the pupil´s contextual understanding of the actual curriculum.

The virtual guide through the Ostrava Zoo consists of six parts, which represent the individual stops during the excursion. The excursion is presented to the pupils as a didactic game in the form of an adventurous expedition. The initial part is instructional and motivational: the pupils learn to handle the educational application on a tablet, they can read short medallions about the author and co-authors of the application and watch a video about the history and realia of the visited institution.

The educational application consists of individual stops at five animals – greater flamingo, red panda, hippopotamus, Asian elephant and Asian black bear. These five animals were chosen for two reasons:

- appropriate and equal spacing of the animal expositions which allowed touring through the zoo from the entrance to the symbolic “cemetery of extinct animals” without detours, with regular stops and many attractive activities during the tour;

- the choice of these specific animals allows for using semantic networks which represent various structures or systems in zoology so that pupils become acquainted not only with the individual concepts, but also with the various types of relationships between them (ecological links, food chain, taxonomic system, etc.).

Stopping for each animal consists of three parts:

- multimedia presentation of information about the animal, which complements the teacher´s commentary and which should point the pupils to observe the animal and ask additional questions;
- presentation of various zoological systems that the animal belongs to, using animated semantic networks with voiceover commentary in the form of a dialogue between a boy and a girl;
- a formative evaluation using incomplete semantic networks, where the pupils have to complete these networks by choosing from multiple options and are informed immediately about the results.

The path to the next animal is only revealed to the pupil teams when they can pass the tests without a single error. After the successful completion of the semantic networks, an animated interactive map is revealed to the teams, which guides them to the next animal. On the way to the next stop the maps suggests additional educational or recreational activities.

After testing during the pilot and experimental instruction, evaluation and necessary adjustments the virtual guide was placed on the Ostrava Zoo web page (Ostrava Zoo) and anyone can download it for free onto their tablet. Besides the primary school pupils, the other target groups are children´s clubs and families with children.

## 5. Evaluation

In terms of objectives the coherence model of instruction can be deemed as efficient if the following conditions are met:

- The coherence model of instruction has a positive influence on understanding the whole, the internal and external relationships between single objects and evolutionary influences.
- The coherence model of instruction has a positive impact on a long-term retention of curriculum.

The evaluation of the coherence model and virtual guide was carried out by three methods: observation of behaviour and work of pupils during the experimental instruction, a pedagogical experiment and evaluation questionnaire. The results of the research methods – the pedagogical experiment and evaluation questionnaire – were compared and complemented with insights from observing the pupils' behaviour.

The experimental instruction with virtual guide was attended by primary school pupils (primary school Majakovský in Karviná, Czech Republic) from two different grades: 4$^{th}$ grade – 9 years of age and 5$^{th}$ grade – 10 years of age, altogether 47 pupils. The pupils were divided into groups (separately for each grade) in such a way, so that the degree of understanding in context of the science curriculum for both the control and experimental group would be comparable. The only difference (independent variable) between the two groups was that the pupils from the control group did not work with self-tests using semantic networks.

The pedagogical experiment is described in a paper (Kapoun, 2016). Nevertheless, for the sake of completeness, we mention the results of the comparison of the level of pupils for both control and experimental group in pretest, post-test and retest.

- Based on the test results and statistical analysis, it can be assumed that the virtual guide through educational exposition, which was designed and implemented according to the principles of coherence model of instruction, has a positive impact on the understanding of the curriculum in context and on the ability of contextualization.
- Furthermore, on the basis of the test results and statistical analysis, it can be assumed that the virtual guide through educational exposition, which was designed and implemented according to the principles of the coherence model of instruction, has a positive effect on curriculum retention in long-term memory.

This paper concentrates on the methods and results of the evaluation questionnaire.

### 5.1 Evaluation questionnaire

The second method for evaluating the coherence model of instruction was an evaluation questionnaire. The survey covered the first two levels of Kirkpatrick´s four-level evaluation model (Businessballs, 2016): feedback from the participants of the educational process and the evaluation of the growth of knowledge and understanding in context.

The goal of the evaluation questionnaire while evaluating the virtual guide through educational exposition (and by implication, the coherence model of instruction), was to find out the subjective evaluation of the experimental instruction by the pupils. The evaluation questionnaire contained four pairs of questions concerning the four pillars of coherence model of instruction, or respectively their application – a virtual guide through the Ostrava Zoo:

- instruction in an authentic environment, in this case an excursion in the zoo;
- cooperative learning, that is cooperation in expedition teams;
- activating teaching methods, in this case supporting application on tablets;
- spatial learning strategies, such as animated semantic networks with voiceover commentary.

For each of the four subjects two questions were asked:

- the first question examined feelings and emotions of the pupils, i.e., how much fun, satisfactory or better emotionally or more likeable something was;
- the second question was aimed at a preferably rational evaluation of the educational benefits for each of the four pillars of the coherence model of instruction by the pupils.

*The process of evaluation poll*

The evaluation questionnaires were filled in by pupils from both 4$^{th}$ and 5$^{th}$ grade in both control and experimental groups. The questionnaire was anonymous, although the respondents were asked to specify their gender – boy/girl.

The data from the evaluation poll were tabulated. All processing and hypothesis testing were carried out separately for 4$^{th}$ and 5$^{th}$ grade. Given the fact that the condition for normal distribution was not met, a nonparametric test was chosen for testing the hypotheses. The data was processed using a statistical program NCSS 11 (NCSS, 2015).

Based on the average ratings the pupils rated the instruction in authentic environment (excursion in the zoo) and cooperative learning (working in the expedition teams) the highest. In both cases it was true for the evaluation of the pupils´ impressions of the instruction as well as for the evaluation of the educational benefits.

*Evaluation of the experimental instruction by boys and girls*

The average ratings indicated that girls rated the instruction higher than boys. This concerns mostly cooperative learning, both in terms of impressions, as well as in terms of the educational benefits. This is consistent with the observation during the experimental instruction. While girls worked actively in teams, boys lost their interest and ceased to cooperate. To statistically prove better rating of the instruction by girls, both null hypothesis and alternative hypotheses were formulated.

Null hypothesis: The rating of the experimental instruction by boys and girls does not differ.

Alternative hypothesis: The rating of the experimental instruction by boys and girls is different.

*Note: G1 (D) = girls; G2 (Ch) = boys.*

**Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians**

| Alternative Hypothesis | Z-Value | Prob Level | Decision (5%) |
|---|---|---|---|
| Ch<>D | 2,9298 | 0,003392 | Reject Ho |
| Ch<D | 2,9298 | 0,998304 | Accept Ho |
| Ch>D | 2,9298 | 0,001696 | Reject Ho |

**Plots Section**

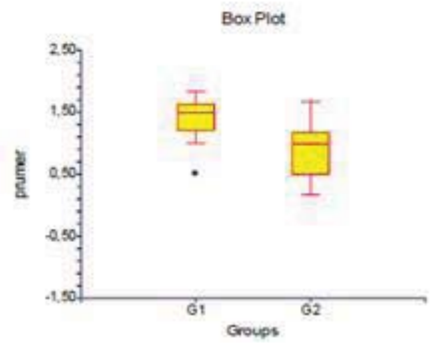


**Figure 2:** Rating of the experimental instruction by boys and girls from 4th grade

**Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians**

| Alternative Hypothesis | Z-Value | Prob Level | Decision (5%) |
|---|---|---|---|
| Ch<>D | 2,5932 | 0,009508 | Reject Ho |
| Ch<D | 2,5932 | 0,995246 | Accept Ho |
| Ch>D | 2,5932 | 0,004754 | Reject Ho |

**Plots Section**

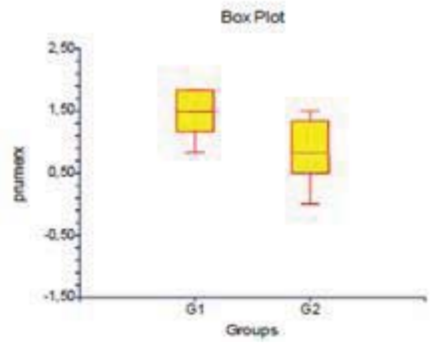


**Figure 3:** Rating of the experimental instruction by boys and girls from 5th grade

Based on the results of statistical analysis the null hypothesis at significance level $\alpha$=0,05 was rejected, concerning testing in both grades. This means that girls rated the experimental instruction higher than boys. In both grades the difference was caused mainly by higher rating of cooperative learning by girls.

*Evaluating the work with tables*

As proven by observation of the pupils´ behaviour and work during the expedition, working with tablets was not as attractive as expected, with the exception of active work with animated and interactive semantic networks. Both the educational benefit of working with tablets during instruction in case of the virtual guide and using tablets for improving understanding in context were not rated very high. To statistically prove better rating of the work with tablets, both null and alternative hypotheses were formulated.

Null hypothesis: Rating of the work with tablets by control and experimental group does not differ.

Alternative hypothesis: The rating of the work with tablets by control and experimental group is different.

*Note: G1 (E) = experimental; G2 (K) = control.*

**Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians**

| Alternative Hypothesis | Z-Value | Prob Level | Decision (5%) |
|---|---|---|---|
| E<>K | -1,6676 | 0,095387 | Accept Ho |
| E<K | -1,6676 | 0,952307 | Accept Ho |
| E>K | -1,6676 | 0,047693 | Reject Ho |

**Plots Section**

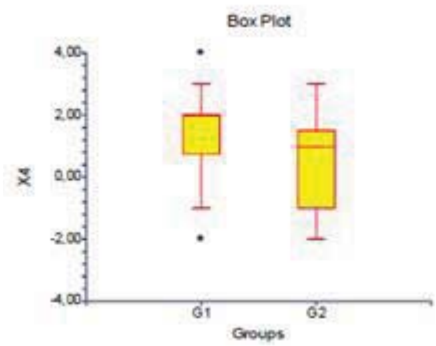


**Figure 4:** Rating the work with tablets and their educational benefit by 4th graders

**Mann-Whitney U or Wilcoxon Rank-Sum Test for Difference in Medians**

| Alternative Hypothesis | Z-Value | Prob Level | Decision (5%) |
|---|---|---|---|
| E<>K | 1,9077 | 0,056430 | Accept Ho |
| E<K | 1,9077 | 0,971785 | Accept Ho |
| E>K | 1,9077 | 0,028215 | Reject Ho |

**Plots Section**

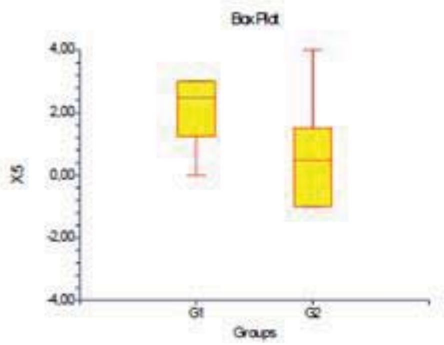


**Figure 5:** Rating the work with tablets and their educational benefits by 5th graders

Based on the results of statistical analysis the null hypothesis at significance level $\alpha$=0,05 was rejected. This justifies the assertion that pupils in the experimental group rated the work with tablets and their educational benefits higher that the pupils of the control group, both in 4th and 5th grade.

## 5.2 Observation of the pupils´ behaviour and work

When observing the pupils´ behaviour and work it became clear that mobile learning where the pupils are expected to carry and look after a tablet is not quite the ideal way of teaching in educational expositions. Ubiquitous learning offers better options since the technology is ubiquitous and a pupil can access the educational content on the site of the activity. This way of teaching brings the following benefits (EduTech Wiki, 2015):

- Safety: The pupil cannot by his/her own failure lose his/her data because all the actions and outcomes of teaching and learning are continuously recorded in the cloud.
- Availability: The pupils can access their applications and documents from anywhere. This information is provided based on their requests, so they are actively involved in managing their learning.
- Immediacy: The pupils can get the required information at the moment of their need and in this way they can solve problems without delay in real time.
- Interactivity: The pupils can communicate with experts, teachers or peers in the place of instruction using synchronous and asynchronous communication.
- Location of teaching activities: Teaching and learning can be embedded in everyday life and the curriculum can be presented outside the classroom in an authentic environment using, for example, methods of problem or inquiry based learning.
- Adaptability: The pupils can obtain the right information at the right place in the right way.

Further findings, listed below, were gained during the experimental instruction:

- The cognitive abilities of the pupils at the first level of primary school are high and sometimes there is a tendency to underestimate them.
- The pupils´ weakness is in the ability to work effectively in teams for the benefit of the whole. This may be due to insufficient use of cooperative forms of teaching in schools and due to lack of such behaviour acted out by adults that the children observe.
- The design for teaching in an environment outside of the classroom has to be based on observation of the natural behaviour of pupils. Usually the opposite is true – an instruction scenario is created and its author or a teacher expects the pupils to adapt their spontaneous behaviour to that scenario.
- As it turned out during the experimental instruction, tablets are apparently not the final technology that would be suitable for all types of expositions.

## 6. Conclusion

Based on the principles of the coherence model of teaching a teaching methodology and an educational application serving as a virtual guide were created. This application was tested by primary school pupils in an authentic environment of educational exposition. The evaluation proved that instruction according to the coherence model has a positive impact on understanding in context and curriculum retention in long-term memory.

For the purpose of evaluation, the following methods were used: observation of pupils´ behaviour and work, a pedagogical experiment and evaluation questionnaires.

The paper presents the processed results– evaluation of questionnaires. Based on these results the pupils rated the instruction in authentic environment (the expedition in the zoo) and cooperative learning (working in the expedition teams) the highest. In both cases it was true: for the evaluation of pupils´ impressions from the instruction as well as for the evaluation of the educational benefits.

The results of statistical analysis shows:

- that girls rated the experimental instruction higher than boys. The difference was caused mainly by higher rating of the cooperative learning by girls.
- that the instruction with tablets is more attractive when pupils work with animated and interactive semantic networks.

Observation of pupils´ behaviour and work was recorded in files and processed by analysis. During the experimental instruction it was learned that tablets are not the ideal tools for teaching and learning in outdoor educational expositions. In many cases stationary specialized devices installed directly on the site of the individual educational activities, wearable technology and the Internet of things are more suitable.

The emerging market of the Internet of things, wearable technology and devices for augmented or virtual reality offers such options. But it is necessary to project their use in education in advance and eliminate situations, in which ways, methods and forms of instruction are developed only after the technologies are already purchased in schools. It is therefore necessary to require the technologies to adapt to teaching and not teaching to technologies.

Further research into the use and educational effects of the coherence model of instruction could continue to explore the individual aspects of the model in laboratory conditions. With the use of the coherence model during actual instruction there is a risk that an experiment will be influenced by a number of intervening variables which may be difficult to identify.

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# A Technique to Enhance Motivational Appeal of Moodle: Design and Evaluation

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**Abstract:** Motivation is a causal factor of learning. This article presents the design and implementation of a motivational technique that builds on the confidence and satisfaction dimensions of the ARCS (Attention, Relevance, Confidence and Satisfaction) motivational model. The proposed technique was embedded in Moodle so as to enhance its motivational appeal by depicting students' progress in a course. However, it can be easily integrated into any other learning system as long as it is able to track a learner's actions within it. In order to calculate knowledge progress, the use of two different measures is proposed: the Time-based Progress Calculation (TPC) and the Grade-based Progress Calculation (GPC). An evaluation study of a Moodle course was conducted in the context of an introductory programming course in order to examine the effectiveness of the proposed technique and students' feedback on it. Three groups were randomly formed. The first two groups had access to a different version of the course in Moodle, while the third had access only to the course's webpage. The study was conducted over the first six weeks of the course, up to the mid-term exam. On completion of the respective course sections but prior to the mid-term exam, the students of the first two groups had to answer a questionnaire evaluating the attended course. The questionnaire consisted of five-point Likert type questions and was divided into two subcategories: system usability and motivational appeal. The aim of our analysis was to investigate whether our motivational technique was able to stimulate students to study more, increase their motivation, and help them to improve their learning outcomes without increasing Moodle's complexity. The results were encouraging since they indicated that the implementation of the proposed technique into Moodle affected students' motivation and involvement, resulting in significantly higher grades on the mid-term exam, while their feedback about its usability was positive.

**Keywords**: learning management system, e-learning, progress calculation, motivation, ARCS model

## 1. Introduction

During the last decade an increasing number of educational institutions all over the world offer e-learning courses. There are many reasons for this growing tendency. One of the most important is the elimination of time, space and social restrictions since e-learning does not require physical presence of the teacher and student. Consequently, e-learning can offer equal learning opportunities to people that cannot attend a typical class, either because they work or because they live far away from universities. Furthermore, the development and maintenance of e-learning systems require less resources compared to those for a typical class. Besides their usage for distance learning, e-learning systems can also be used as supplementary material for conventional classroom education.

Many e-learning systems have been proposed in order to fulfil educational objectives and to achieve better learning results, with Learning Management Systems (LMS) playing a dominant role. These systems offer various sets of tools to support teachers in creating, administering and managing online courses. Teachers have the opportunity to: easily deliver a set of educational resources to students, create new educational resources, develop tests and learning quizzes, start over a discussion and use collaborative learning tools, such as wikis, forums and chats. WebCT, Blackboard and Moodle are some of the most popular LMS which have been successfully used in many courses at universities all over the world, both for traditional and blended learning.

Although e-learning systems are widely used, their effectiveness is sometimes questioned. Selim (2007) identified eight critical success factors for the acceptance of e-learning: instructor's attitude toward and control of the technology, instructor's teaching style, student motivation and technical competency, student–student interaction, course content and structure, ease of Internet access, infrastructure reliability and university support. Student motivation is the extent to which the student makes an effort in and pays attention to various activities (Izmirli and Izmirli, 2015). Motivation is subjective and can be based on personal beliefs, feelings, and/or personal preferences (Baumstark and Graf, 2014). It can be used to direct a student's behaviour towards a particular goal, increase a student's applied effort and energy, increase a student's initiation and persistence in activities, enhance cognitive processing, and it can lead to improved student performance (Omrod, 2007). When motivation to learn is low, the potential to learn may decrease (Hodges, 2004; Wlodkowski, 1985; Yukselturk and Bulut, 2007; Keller, 1999).

The purpose of our paper is to present a motivational technique that is designed according to a specific motivational model and embedded into Moodle in order to depict students' progress in a course. This approach aims to affect students' motivation and involvement and, consequently, their learning outcomes.

The remainder of the paper is organized as follows. The next section gives a short description of ARCS (Attention, Relevance, Confidence and Satisfaction) motivational model. This is followed by a section where the design and implementation of the proposed motivational technique are described. After there is the section, where the evaluation study is presented, and in the final section are the conclusions.

## 2. ARCS motivational model

One of the commonly used motivation models is Keller's ARCS motivation model (Keller, 1987). ARCS model is a method for improving the motivational appeal of a course and is based upon the idea that there are four key elements in the learning process, which can encourage and sustain learners' motivation. Each one of the above conceptual categories includes different strategies that can be applied so as to improve a learner's motivation to learn.

As regards the first category, attention is an element of motivation and a prerequisite for learning (Keller, 1987). While on the one hand it is very easy to draw a learner's attention, for example with a video or an animation, this is not enough. The challenge is achieving to sustain it throughout the duration of the course. Strategies that can be used in order to draw and sustain a learner's attention includes perceptual and inquiry arousal, as well as variability, such as incongruity and conflict, concreteness, humour, inquiry, and participation (Keller, 1987).

Relevance refers mainly to the clarification of the reason why students should study for their lessons. Determining learners' interests and associating their interests with instruction are among relevance strategies (Izmirli and Izmirli, 2015).

Concerning confidence, we have to mention that fear of failure is often stronger in students than teachers realize (Keller, 1987). The lack of confidence can decrease a student's persistence and, subsequently, reduce learning effectiveness. Teachers, in order to improve motivational appeal of a course, must foster the development of confidence in students. They should be encouraged to attend courses regularly and to become successful in those courses (Izmirli and Izmirli, 2015). Confidence strategies include learning requirements, success opportunities, and personal control, such as difficulty, expectations, attributions, and self-confidence. A clear statement of learning goals and the organization of learning materials from simple to complex are among the above strategies. Learners must form the impression that some level of success is possible if effort is exerted (Keller, 1987).

The last category of satisfaction includes strategies that can make students feel good about their accomplishments. Satisfaction strategies include intrinsic reinforcement, extrinsic rewards, and equity, such as natural consequences, unexpected rewards, positive outcomes, negative influences, and scheduling (Keller, 1987).

Based on the above assumptions, researchers consider the proposed strategies in order to develop e-learning systems with improved motivational characteristics. Usually, researchers implement some of the above techniques in the context of their learning system. Thus, the specific implementations are domain and content dependent and cannot be easily reused in other systems. Baumstark and Graf (2014) proposed a generic framework for integrating motivational techniques in learning systems according to the ARCS motivational model. Recent research validates the assumptions of this model either with qualitative (Izmirli and Izmirli, 2015) or quantitative methods (Huett et al., 2008). Graf, Lachance, and Mishra (2015) proposed the design and implementation of four motivational techniques based on previous work (Baumstark and Graf, 2014). These techniques were system and content independent, and can therefore be used in any learning system and for any course. The techniques were integrated into Moodle and verified only through case studies. The progress annotation technique (Graf, Lachance, and Mishra, 2015) based the annotation on students' statements on whether learning objects were "completed", "in progress" and "not started". Another motivational plugin that was developed exclusively for Moodle is the Progress Bar block (Docs.moodle.org, 2016). The Progress Bar block is a time-management tool that calculates students' progress based on pre-specified deadlines. More specifically, a different deadline is set for each activity in Moodle and each activity is annotated as "complete" or “incomplete” after the specified date, regardless of the time that they have been studied in. We propose a technique which is system and content independent and is implemented in Moodle. Although it looks similar to the progress annotation techniques mentioned above, it has a major difference. Since our intention was to design a more objective technique, progress in our approach is automatically calculated by the system, based on actual data, such as the duration of students’ actions that are gathered through students’ interaction with Moodle.

## 3. Proposed motivational technique

The purpose of our paper is to present a motivational technique that is designed according to the ARCS motivational model and embedded into Moodle so as to depict a student’s progress in a course and, as a consequence, to affect a student’s involvement. In order to apply this technique we designed an introductory programming course in Moodle which consisted of five sections. In accordance with the first dimension of the ARCS model, namely the attention, which claims that variability in educational material can draw and sustain a learner’s attention, we decided to use seven different types of learning objects. Therefore, each section consists of: an outline, contents objects, videos, solved examples, one quiz, an open-ended question and a conclusion. The outline presents an overview of the educational objectives of the current section. Content objects present the theory of the section. In order to support flexibility during studying, we decided to segment these objects into smaller ones so that each consists of one or two of the concepts that are presented in the current section. Videos explain basic concepts of theory and provide hints for problem solving. Solved exercises consist of a description of an exercise and its solution. Quizzes include multiple close-ended questions where each one of them demands prediction of program output or filling gaps in a program. Open-ended questions include a small piece of code and the learner must predict its output and reason for this prediction. Finally, the conclusions summarize the main points of the current section’s theory.

In order to design the motivational technique according to the ARCS motivational model and embed it in Moodle, the overlay model was used so as to represent a learner’s knowledge progress. In this model, the student’s knowledge is considered to be a subset of the expert’s knowledge (Beck, Stern, and Haugsjaa, 1996). During the learning experience, the student acquires knowledge with the expectation of reaching the expert’s level, yet without being able to learn anything more or anything different to him/her. In order to calculate the learner’s knowledge progress, the use of two different measures is proposed: the Time-based Progress Calculation (TPC) and the Grade-based Progress Calculation (GPC).

As regards the first measure, we extended Moodle’s authoring tool enabling it –apart from open-ended questions- to store for each type of learning object two different time values, namely t_min and t_max. Additionally, one more value named w is stored for each type of learning object, including open-ended questions. The t_min value represents the minimum time that is required for a learner to study the specific learning object in order for it to be considered as “known”. The t_max value represents the maximum time that a learner can study it, and it prevents the system from attaining spurious results. Time values beyond this limit signify that Moodle probably is in an idle state and the learner is involved in doing something else apart from actually studying that particular learning object. Thus, if a time value exceeds the t_max value, the specific time value will not be considered and the respective learning object will be considered as “unknown”. Open-ended questions are considered as “known”, concerning time progress, if a solution is submitted, regardless of the time that the learner spent on them. The w value indicates the weight of importance of the specific learning object and it ranges from 0 to 1. The sum of w values for all the learning objects of a section equals 1. Having defined the above values, TPC of a section is defined as follows:

$$TPC = \frac{1}{N} \sum_{i=1}^{N} f(t_i) \times w_i$$

N stands for the quantity of learning objects of the specific section, $w_i$ is the weight of importance of the i-th learning object, and function f is defined as following.

$$f(t) = \begin{cases} 0, & t<t\_min \text{ or } t>t\_max \\ 1, & t\_min \le t \le t\_max \end{cases}$$

The second measure of a learner's progress (GPC) refers to his/her performance on Moodle activities that can be graded. According to our course structure, such activities are quizzes and open-ended questions. Each section includes one quiz and one open-ended question. Due to the fact that the quiz consists of several questions and, thus, is more demanding than the open-ended question, we decided that the two grades would not contribute equally to GPC measurement but with different weights, 70% and 30% respectively. Therefore, the GPC of a section is defined as follows:

$$GPC = 0.7 \times grade_{quiz} + 0.3 \times grade_{open\text{-}ended}$$

In sum, the TPC for a section measures how much of a section's learning material for that section is considered as known in relation to the student's effort, whilst GPC measures a learner's performance in the specific section. The student's performance is not indicated if only the TPC values are taken into account. Likewise, taking into consideration only the GPC values is unreliable because there is no evidence of the student's effort. We believe that a combination of the two constitutes an adequate way to estimate a learner's progress in a specific section. TPC and GPC are depicted in each section of the course with the help of two independent progress bars as illustrated in Figure 1.


**Figure 1:** Screenshot of a course section in Moodle for Group 1

## 4. Evaluation study

In order to evaluate the effectiveness of the proposed motivational technique, we conducted an evaluation study, during the winter semester of the 2015/16 academic year in the context of the Procedural Programming introductory course, taught in our department. It consists of a 2-hour weekly lecture and a 2-hour weekly laboratory where students practice and solve a problem. The course's total length is 13 weeks. The evaluation study was conducted over the first six weeks of the course, until the mid-term exam. During this time, five sections about the fundamental concepts of procedural programming were presented to students, namely an introduction (I/O statements, data types, assignment statement), if statements, loops, functions and arrays.

Three groups of students were formed, namely Group 1, Group 2 and Group 3, based on students' preferences. More specifically, after the students were informed of the groups' differences, they were asked to express their preference for the group they wanted to be assigned to. It should be pointed out that all students received similar grades in the University Admission Exams in order to study computer science, which was their first choice. Consequently, they have comparable academic profiles and, therefore, it can be assumed that they were equally motivated and involved in their studies. In addition, since the three groups were self-selected, it is possible that those who chose to try the new method may have already been more motivated and involved in their studies. In order to contradict this hypothesis, we investigated the three groups' average grades in a similar course that is also taught in the first semester in our department, namely "Algorithms in C". There was a slight difference between the average grades of Group 1 with a mean score of 5.94 (SD = 2.417), Group 2 with a mean score of 5.73 (SD = 2.604), and Group 3 with a mean score of 5.67 (SD = 2.093). However, none of these differences was found to be statistically significant. Thus, it can be assumed that the three groups were equally involved in their studies and any differences in the study results could more likely be attributed to the proposed mechanism. All groups attended the same lectures and laboratories, whilst different e-learning environments for studying and practicing were used. More specifically, Group 1 and Group 2 used Moodle, and Group 3 the course's webpage.

This webpage includes the same educational material as one unified presentation, unlike Moodle where the material is organized as different learning objects. The difference between the first two groups was the way that the progress bars were displayed. Students in Group 1 were able to view their progress bars for each section right after its content (Figure 1), while those in Group 2 had to request their progress bars, which were displayed in a new window (Figure 2). It was decided to use two different ways to display the progress bars in order to investigate their effectiveness. The first way (Figure 1) is more direct as it does not demand any additional effort in order for a student to view his/her progress bars. The second way (Figure 2), however, requires that the student request to view his/her progress bars and must therefore, make additional effort required. Moreover, a student should contemplate the bars and relate them to the respective sections. Thus, the second way increases a student's cognitive load, whereas the first one directly motivates students without demanding their mediation and it is expected to be more suitable especially for first-year students, as were our study.


**Figure 2:** Screenshot of progress bars in Moodle for Group 2

On completion of the 5 sections of the Moodle course but prior to the mid-term exam, students in Group 1 and Group 2 had to answer a questionnaire evaluating the course that they attended. Finally, 234 students participated in the study and also took the mid-term exam. They were equally assigned to each group. Thus, each group consisted of seventy-eight students. The aim of our analysis was to investigate whether our motivational technique manages to stimulate students to study more, increase their motivation, and help them to improve their learning outcomes on the mid-term exam.

The questionnaire was divided into two subcategories concerning two different areas of interest, namely the usability and the motivational appeal of the system. Students were asked to respond to six and five questions, respectively. The questionnaire consisted of five-point Likert type questions, ranging from 1 'strongly disagree' to 5 'strongly agree'. The findings are presented in Table 1 and Table 2 respectively.

**Table 1:** Student feedback on the usability of the system

| Question | Group 1 | | Group 2 | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| Pages loaded fast | 3.9 | 0.896 | 3.9 | 0.831 |
| Navigation was easy | 4.2 | 0.858 | 4 | 0.806 |
| Links were expressed definitely | 4.3 | 0.851 | 4.3 | 0.839 |
| System was user-friendly | 4 | 0.904 | 4 | 0.856 |
| System was considered adequate for novices | 4.1 | 0.866 | 3.9 | 0.957 |
| Easily familiarized myself with the system | 4.4 | 0.868 | 4.4 | 0.787 |

Students' answers indicate that system usability cannot be questioned as average scores are significantly high. Moreover, the results are quite similar for the two groups, indicating that the system's usability is independent of the way the progress bars were visualized in Moodle. More specifically, the system is characterized as user-friendly with an average score of 4 on the Likert scale for both groups. There is a slight difference between the responses of Group 1 with a mean score of 4.2 (SD = 0.858) and Group 2 with a mean score of 4 (SD = 0.806) for the item regarding 'navigation convenience'. However, this difference was not found to be statistically significant. In addition to these, students believe that the system is considered to be adequate for novices with mean values of 4.1 and 3.9, respectively. Perhaps one of the most important findings is the last question in Table 1. Since the students that were enrolled in Moodle were in the first year of their studies and were not accustomed to the use of LMS, it would be expected that they would come up against problems in their attempts to learn to use the system. Nevertheless, they stated that they easily familiarized themselves with the system with an average score of 4.4 for both groups, which in effect means that they had a positive attitude to the system's usability. At this point it should be pointed out that there were no statistically significant differences, even for those questions that had slightly different mean values.

**Table 2:** Student feedback on the motivational appeal of the system

| Question | Group 1 | | Group 2 | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| System motivated me to study more | 4.1 | 0.967 | 3.6 | 0.986 |
| System helped me to learn easier | 4.2 | 0.833 | 3.9 | 0.885 |
| I'm generally satisfied with system usage | 4.0 | 0.904 | 3.9 | 0.985 |
| Visualization bars of my progress motivated me to study more | 3.9 | 1.132 | 3.1 | 1.181 |
| Quality of educational resources | 4.1 | 0.622 | 4.1 | 0.574 |

As can be seen from the results in Table 2, all students were generally satisfied with the use of Moodle and the quality of the educational resources. Perhaps the most important finding in Table 2 is that concerning whether the progress bars motivated students to study more. The average score for Group 1 was 3.9 (SD = 1.132), and for Group 2 was 3.1 (SD = 1.181), the difference of which was statistically significant (p-value was less than 0.05). This result confirms our initial assumption that being able to see the progress bars immediately after each section's contents is better comparatively to seeing them in a new window for all the sections. Feedback concerning the system's motivation to study more and the system's help to learn easier also confirmed that the way Group 1 could see the progress bars was more advantageous for students. The differences of the mean values for the specific questions between the two groups were also found statistically significant ($U = 1679.5$, $p = 0.002$ for the first question and $U = 1890$, $p = 0.027$ for the second).

Table 3 presents the findings related to the question whether our motivational technique improved students' grades on their mid-term exam, which incidentally was graded out of 30.

**Table 3:** Student performance

| | Group 1 | | Group 2 | | Group 3 | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| Grade | 20.11 | 6.953 | 17.33 | 8.948 | 13.38 | 7.730 |
| TPC (%) | 61.78 | 27.872 | 32.95 | 27.972 | | |
| GPC (%) | 61.72 | 28.948 | 41.19 | 33.106 | | |

The above findings show that students in Group 1 performed better on the mid-term exam in comparison to those in the other two groups. In addition to this, students in Group 2 also achieved higher grades compared to students in Group 3. The average grades for the three groups were 20.11, 17.33 and 13.38 out of 30, respectively. The first step towards discovering whether these differences was statistically significant at the 95% confidence level was to apply the Kolmogorov - Smirnov test so as to check if the grades were normally distributed. This test revealed that normal distribution did not exist. Since t-test could not be applied, the second step was to apply the two-tailed Mann-Whitney U test (u-test) to compare the grades of the groups. The results are presented in Table 4, indicating that all differences were statistically significant since p-value was less than 0.05.

Furthermore, the results in Table 3 indicate that the proposed mechanism motivates students to become more actively involved in the activity as the mean score of the TPC for Group1 was almost double that of Group2 at 61.78% and 32.95% respectively. This difference was statistically significant at the 95% confidence level ($U = 1977$, $p = 0$). In addition, the Mann-Whitney test applied to compare the GPC values between the two groups revealed that those in the first group had a significantly better performance ($U = 2797.5$, $p = 0$) on the Moodle activities that could be graded ($M = 61.72$, $SD = 28.948$), compared to the second group ($M = 41.19$, $SD = 33.106$).

**Table 4:** Statistical significance of grade differences on the mid-term exam

| | Group 1 – Group 2 | Group 1 – Group 3 | Group 2 – Group 3 |
|---|---|---|---|
| U | 3572.5 | 7902 | 5141.5 |
| p | 0.039 | 0 | 0.001 |

Summarizing the findings of the study, we come to the conclusion that the implementation of the proposed mechanism in Moodle shows a higher level of student motivation and involvement, resulting in significantly higher grades on the mid-term exam. Although one can question the validity of the findings on the basis that students' answers on feedback questionnaires may constitute a subjective point of view, TPC values are an objective measure of students' involvement and can be used in conjunction with student feedback. It should be noted that students did not receive any bonus grades for gaining higher TPC or GPC values; thus, it would be meaningless for them to attempt to deceive the system.

## 5. Conclusions

Students with an increased motivation to learn have a greater learning effectiveness (Dickinson, 1995). Thus, there is a need for further research evaluating learner motivation in online learning environments (Smith, 2008). Trying to contribute to research, we exploit elements from the ARCS motivational model and we propose the integration of a specific motivational technique in Moodle. The proposed technique builds on the confidence and satisfaction dimensions of the ARCS model and can be easily integrated in any other learning system as long as it is able to track a learner's actions within it.

This paper presents the results of an evaluation study on the use of Moodle as supplementary material to the traditional classroom lesson. The reported findings are quite positive since they indicate that our mechanism motivated students to study more and helped them to achieve higher grades on the mid-term exam, while, at the same time, they have a positive attitude concerning its usability.

These preliminary results may provide the basis for further research in the field of motivational theory. Our future work will focus on the design of other motivational techniques that will build on the other two dimensions of the ARCS model, namely attention and relevance, so as to increase the motivational appeal of learning systems. Moreover, the proposed technique will be reviewed in order to discover potential characteristics that can be improved.

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# The Relationship Between EI (Emotional Intelligence) and Speaking Proficiency in e-Learning

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**Abstract:** ELearning is permeating every corner of today's education, language learning in particular. ELearning offers a favorable environment for learning the skill of speaking as well. It furnishes learners with facilities to practice a wide range of speaking activities and a variety of feedback on them. The significance of Emotional Intelligence (EI or EQ), in any type of learning, is undeniable and proved by many. As Darwin posited that emotional expression was essential for survival, it is crucial to consider EI in any stage of the design for the survival of eLearning. Relatively little has been done to highlight the importance of emotional aspects in designing eLearning courses in language learning. Teachers and eLearning course designers need to take into account, among other factors involved, their students' emotional intelligence, which easily can be ignored. Hence, the present study intended to find if there is a significant relationship between EI and Speaking Proficiency of Iranian English Language Learners in eLearning and if such a relationship exists, which of the subcategories of EQ might provide us with a better prediction for SP success. Among 500 volunteered university students wishing to take TOEFL iBT, by administrating Nelson English test, 150 homogeneous participants were randomly selected for the purpose of the study. Participants' ages were between 19 and 22 years old, including both males and females. Firstly, participants' EQ was assessed using Bar-On questionnaire administered on-line. Students then enrolled in a three-month eLearning TEOFL iBT course for speaking on www.elearne.com. At the end of the course, students have participated in TOEFL iBT and informed the researcher of their speaking scores. To analyze the data, Pearson Product Moment correlation coefficient and Multiple Regression have been applied. The results revealed that the correlation between EI and SP is positively significant and among the subgroups of emotional intelligence, the interpersonal aspect provides us with the best prediction for speaking proficiency success in an eLearning course.

**Keywords**: eLearning, emotional intelligence (EQ/EI), speaking proficiency, language learning

## 1. Introduction

The presence of widespread and fast growing technologies is tangible in our everyday communications. We are moving away from the traditional face-to-face contacts to e-communications by the immense use of social networks and digital applications. The prevalence of technologies such as internet, smart phones, etc. is so vast in every corner of our lives that the author prefers to call it "e-life" altogether. By leading such an e-lifestyle, the use of e-learning in the realm of education, language learning in particular, is no longer considered inauthentic. The employment of e-learning in any educational field, specifically language learning, is indeed irrefragable for the very fact that students can't imagine their daily life without having their personal computers, iPads, etc (Shishkovskaya et al., 2015). Hence, teachers' main objective should be to figure out how to maximize the potential of these devices to improve the efficiency of education. Likewise, some studies emphasize the rapid growth of computer-based technology for the delivery of educational content alongside students' preference towards such instruction(Behnke and Greenan, 2011). Consequently, as the use of e-learning progresses, we have to synchronize ourselves with it and incorporate technology with our teaching/learning process(Mohammadi et al., 2011).

### 1.1 ELearning and its merits

Among various attempts to define what e-learning is, it can be mentioned that eLearning is an intentional use of networked information and communication technology in teaching and learning (Naidu, 2003). Other scholars prefer to consider e-learning as learning with the application of all kinds of electronic tools (for example: multimedia presentations, computers, interactive whiteboard, smart-phones, etc.) (Anderson, 2005; Steen, 2008)Whatever the definition is on the paper, eLearning is what we need to prepare learners to become modern specialists for today's world.

The list of eLearning merits is too enormous to mention but here is a gist:

- Lately, the recent trends in education have been suggesting and emphasizing the significance of learners' role; similarly, eLearning has aimed to turn the pedagogical strategies from teacher-centered to student-centered and turn (Cai, 2012) the role of the teachers and course designers to facilitators of the process of learning (Mohammadi et al., 2011).

- Learners are no longer obliged to be desk-bound or tied to fixed schedules as Carley mentioned flexibility and adaptability as considerable characteristics of eLearning lessons, i.e. students can start and complete their tasks at any time which is convenient for them. (Carely, n.d.; "The Impact of E-Learning in Medical Education," n.d.; Welsh et al., 2003)
- delivery and availability of constant content and messages(Rukavina et al., 2002)
- e-learning offers a time-saving and cost effective learning (Carley, n.d.; "The Impact of E-Learning in Medical Education," n.d.; Welsh et al., 2003)
- On the contrary to the myth that e-learning is an individual learning style, It provides numerous cooperative learning opportunities by the use of chats, forums, team projects and etc. (Carley, n.d.; Mohammadi et al., 2011)

All in all, equal quality of e-learning in comparison with traditional approaches and sometimes even the outperformance of eLearning has been proved (Krentler and Willis-Flurry, 2005; Shishkovskaya et al., 2015; Sivin-Kachala and Bialo, 1994; Summers et al., 2005; Warren and Harold L. Holloman, 2005).

## 1.2 EQ and its merits in education

Recently, psychologists have come up with a type of intelligence which fulfils a much more effective function than the intelligence quotient in humans' endeavors in life. According to (Goleman, 1998) , a prominent psychologist in the field of Emotional Intelligence, EI accounts for 80% of the reasons for one's success in life and education.

The term EI had been popularized by Goleman's publication of his famous book entitled Emotional Intelligence in 1995. In his book, he argues that intelligence quotient (IQ) can be less important than emotional quotient (EQ) when it comes to predicting a student's competence. (Goleman, 1995)defines EQ as "abilities such as being able to motivate oneself and persist in the face of frustration, to control impulses and delay gratification; to regulate one's moods and keep distress from swapping the ability to think; to emphasize and to hope" (P.34). Mayer and Salovey define Emotional Intelligence as "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions"(Salovey and Mayer, 1990). (Baron, 2006) defines EQ as being concerned with effectively understanding oneself and others, relating well to people, and adapting to and coping with the immediate surroundings.

A great number of studies have declared the positive relationship between EQ, emotional aspects and educational success(Aghasafari, 2006; M and R, 2007; Nelson et al., 2006; Oz, 2015; Stottlemyer, 2002) . as Bora pinpoints the significance of emotion in learning: " The emotions can optimize the learning experience, prepare the learner for novel learning experiences and can contribute to the awareness of learners about their needs, goals, and others' emotions"(Bora, 2012).

## 1.3 Review of literature

While considering the vital role of emotions and EQ in learning a second or foreign language in traditional settings (Alavinia and Alikhani, 2014; Oz et al., 2015; Petrides and Furnham, 2000; Pishghadam and Ghonsooly, 2008; Zafari and Biria, 2014; Zarezadeh, 2013).we should not miss the point that such emotional contributing factors are still at work in learning languages in e-learning contexts.

As Darwin states In his book The Expression of the Emotions in Man and Animals, Charles Darwin considered emotions to play a crucial, universal role in adaptation and survival(Darwin et al., 1998), the inclusion of emotional aspects seems likewise necessary for the survival of e-learning. Bringing computer-based learning as a portion of e-learning into educational curriculum poses a particular challenge of matching students' personal characteristics, such as emotional intelligence, with appropriate instructional design and methods. Taking students' emotions and their intrinsic motivations into account in the design of e-learning materials such as computer-based ones, will help them learn better and participate more in the process of learning(Behnke and Greenan, 2011). As a matter of fact it is believed that by including the emotional dimensions into models of online learning, the results would be richer and more authentic (O'Regan, 2003). Moreover, according to a study conducted by Berenson, Boyles, Weaver, (2008), EI was the primary predictor of academic success in online courses(Berenson et al., 2008).

E-learning for sure has paved its way into English language learning/teaching in the past few decades and proved its efficiency in the field(Cai, 2012; Hercik et al., 2015; Hubackova, 2015; Kitagaki, 2012). Form elsewhere it can be inferred that using e-learning to acquire English can reduce the amount of expenses and time(Mohammadi et al., 2011). In parallel to other areas of e-learning, EQ is a determining, influential factor in learning English as a foreign or second language through e-learning. The importance of such factor in e-learning becomes even more obvious when it comes to teaching/learning speaking which is believed to be one of the most challenging skills(Bora, 2012).

While investigating e-learning techniques and methods proved to be effective on learning how to speak English as a foreign language(Kitagaki, 2012) and that e-learning provides learners with contextualized environment by using internet or the opportunity to communicate with native speakers via chat rooms (Mohammadi et al., 2011) the active role of EI in learning the productive skill of speaking English should not be overlooked (Bora, 2012).

Despite its considerable contributions to success in almost all parts of education, little has been done so far to investigate the role and impact of EI in e-learning(Imel, 2003) . Similarly, studies in e-learning have lagged far behind in bringing into account the paramount importance of EI on learning skills of English as foreign language and speaking in particular. The present study, therefore, is an attempt to fill in this research gap and shed more light on the interplay.

### 1.4 Hypotheses and research questions

The study aims to find if there is a significant relationship between EI and Speaking Proficiency of Iranian English Language Learners in eLearning and if so which of the subcategories of EQ provides us with a better prediction for SP success.

## 2. Method

### 2.1 Participants

Among 500 volunteered university students wishing to take TOEFL iBT, by administrating Nelson English test, 150 homogeneous participants, in intermediate level, were randomly selected for the purpose of the study. Participants' ages were between 19 and 22 years old, including both males and females.

### 2.2 Materials and procedures

Three instruments were used for the purpose of data collection. The first one was the Nelson English Test which was used to homogenize the volunteers. The reliability of the test turned out to be 0.9. This test, which contains 50 items, was administered electronically on. The second instrument utilized in this study was Emotional Intelligence questionnaire (Bar-On's EQ-i) which was also administered online to the randomly selected homogenized participants. The results of this test were used as the EQ variable containing discrete values ranging from zero to 450. To avoid cross-cultural differences and to make sure Iranian students thoroughly understand the questions, the translated Persian version of this questionnaire was employed. This adjusted version was decreased into 90 items and the Cronbach's Alpha reliability index was reported as .80 (Samouei, 2002)Bar-On test is a self-report questionnaire containing five main domains or scales and fifteen sub-domains or sub-scales:

- 1. Intrapersonal skills (self-regard, emotional self-awareness, assertiveness, independence, and self-actualization)
- 2. Interpersonal skills (empathy, social responsibility, and interpersonal relationships)
- 3. Adaptability (reality testing, flexibility, and problem solving)
- 4. Stress management (stress tolerance and impulse control)
- 5. General mood (optimism and happiness)

Each question was designed based on a 5-point Likert scale scoring from 5 to 1 (completely agree = 5 to completely disagree = 1). Consequently the maximum score of the test would be 450. Afterwards, participants have enrolled in a 4-month eLearning TOEFL iBT speaking preparation course on www.elearne.com in which all learners received equal amount and mode of instructions and testing systems; during the whole course participants were only in touch with the instructor and each other electronically: typing or leaving recorded voices in forums, social networks, or via emails. No online classes were used; instructions were recorded and videos of each session was available online to be watched or downloaded. Finally, over a month and a half, all participants took TOEFL iBT tests administered by ETS and informed the researcher of the speaking scores, which were discrete values ranging from zero to 30, representing the Speaking Score variable of the study. Such test was chosen to meet the requirements of the research; not only TOEFL iBT is a standardized test but it also applies eLearning testing systems.

### 2.3 Analysis

For the purpose of data analysis, the variables included the EQ and its subgroup scores and Speaking scores. Pearson Product Moment correlation coefficient was applied to analyze two sets of scores obtained from Bar-On and TEOFL iBT test to find out whether there is a significant relationship between EI and SP. And Multiple Regression have been used to come up with the best predictor of SP success among sub-scales of EI.

## 3. Results

After obtaining the results from EI and speaking tests, the Pearson product correlation was run over the two sets of scores and the results are shown in table 1.

**Table 1:** Correlation between EI and SP

| | | SP | EI |
|---|---|---|---|
| SP | Pearson Correlation | 1 | ,558** |
| | Sig. (2-tailed) | | ,000 |
| | N | 150 | 150 |
| EI | Pearson Correlation | ,558** | 1 |
| | Sig. (2-tailed) | ,000 | |
| | N | 150 | 150 |

As it can be seen from the results of table1, there is a significant correlation between EI and SP scores at the 0.01 level (2-tailed). The number 558 shows an above moderate uphill (positive) relationship between EI and SP scores. The number 150 indicates the total number of participants. As far as Sig (2-Tailed) value is less than .05 one can conclude that there is a statistically significant correlations between our two variables

**Table 2**: SUMMARY UTPUT

| Regression Statistics | |
|---|---|
| Multiple R | 0.662964 |
| R Square | 0.439521 |
| Adjusted R Square | 0.376781 |
| Standard Error | 2.886387 |
| Observations | 150 |

The value of Multiple R, ranging from zero to one, indicates how strong the linear relationship is. As far as the value of Multiple R turned out 0.663, it can be said that the strength of such relationship is pretty desirable. R square value turned out to be 0.439 which indicates the presentence of a real relationship between the predictor (EQ) and the response variable (SP). The standard error or standard deviation has been calculated 2.886. The letter "N" stands for the Number of observations which has been 150 participants.

**Table 3:** ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 15 | 875.4551 | 58.36368 | 7.005409 | 4.35E-11 |
| Residual | 134 | 1116.385 | 8.33123 | | |
| Total | 149 | 1991.84 | | | |

As calculated in ANOVA table, the value of F is great enough to be considered significant and leads to the conclusion that there is a significant difference between the variables.

**Table 4:** Predictor sub-scale

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% | Coefficients |
|---|---|---|---|---|---|---|---|---|---|
| Intercept | -2.579 | 2.967 | -0.869 | 0.386 | -8.446 | 3.288 | -8.446 | 3.288 | -2.579 |
| variable 1 | 0.091 | 0.120 | 0.758 | 0.450 | -0.147 | 0.329 | -0.147 | 0.329 | 0.091 |
| variable 2 | -0.067 | 0.108 | -0.622 | 0.535 | -0.280 | 0.146 | -0.280 | 0.146 | -0.067 |
| variable 3 | 0.033 | 0.109 | 0.298 | 0.767 | -0.184 | 0.249 | -0.184 | 0.249 | 0.033 |
| variable 4 | 0.182 | 0.100 | 1.812 | 0.072 | -0.017 | 0.380 | -0.017 | 0.380 | 0.182 |
| variable 5 | -0.054 | 0.105 | -0.518 | 0.605 | -0.262 | 0.153 | -0.262 | 0.153 | -0.054 |
| variable 6 | 0.252 | 0.105 | 2.388 | 0.018 | 0.043 | 0.460 | 0.043 | 0.460 | 0.252 |
| variable 7 | -0.030 | 0.110 | -0.271 | 0.787 | -0.248 | 0.188 | -0.248 | 0.188 | -0.030 |
| variable 8 | 0.349 | 0.076 | 4.585 | 0.000 | 0.198 | 0.499 | 0.198 | 0.499 | 0.349 |
| variable 9 | -0.033 | 0.109 | -0.302 | 0.763 | -0.247 | 0.182 | -0.247 | 0.182 | -0.033 |
| variable 10 | 0.227 | 0.114 | 1.988 | 0.049 | 0.001 | 0.454 | 0.001 | 0.454 | 0.227 |
| variable 11 | 0.138 | 0.078 | 1.767 | 0.080 | -0.016 | 0.292 | -0.016 | 0.292 | 0.138 |
| variable 12 | -0.036 | 0.115 | -0.311 | 0.756 | -0.264 | 0.192 | -0.264 | 0.192 | -0.036 |
| variable 13 | -0.138 | 0.105 | -1.308 | 0.193 | -0.346 | 0.071 | -0.346 | 0.071 | -0.138 |
| variable 14 | 0.103 | 0.093 | 1.104 | 0.271 | -0.081 | 0.287 | -0.081 | 0.287 | 0.103 |
| variable 15 | -0.001 | 0.097 | -0.010 | 0.992 | -0.193 | 0.192 | -0.193 | 0.192 | -0.001 |

- The following traits bellow assigns to each variable
- Variable# 1: Problem Solving
- Variable# 2: Happiness
- Variable# 3: Independence
- Variable# 4: Stress Tolerance
- Variable# 5: Self-Actualization
- Variable# 6: Emotional self-awareness
- Variable# 7: Reality Testing
- Variable# 8: Interpersonal Relationship
- Variable# 9: Optimism
- Variable# 10: Self-Regard
- Variable# 11: Impulse control
- Variable# 12: Flexibility
- Variable# 13: Social Responsibility
- Variable# 14: Empathy
- Variable# 15: Assertiveness

The higher the value of Coefficients (first column from the left), the better prediction we will have. Therefore, the 8th variable (Interpersonal Relationship) provides us with the best prediction of students' speaking score, and the 6th variable (Emotional self-awareness) is the second best predictor.

## 4. Discussion and conclusion

As eLearning becoming more and more popular in the field of education, including foreign language learning, it gets more important for administrators, course designers and teachers to realize factors which can provide optimum implementation of eLearning and better prediction of potential academic success. Among many contributing factors the centrality of EI gained popularity in recent years; high EI is considered as an important characteristic of successful students for the achievement of eLearning programs. Hence the present study examined the possible relationship between EI and oral proficiency in eLearning.

On the basis of the findings of this study, it can be claimed that there is a significant relationship between students' total Emotional intelligence and their Speaking Proficiency. Therefore, the findings support the main hypothesis of the research. The results are congruent with the findings of (Bora, 2012; Salovey and Mayer, 1990)The findings of the study indicate the fact that as long as humans are involved and concerned in a setting, be it traditional or electronic, emotions matter and play their crucial roles.

Interestingly, the results reveals that Interpersonal Relationship aspect of EI gives us a better prediction for future success in SP, which is in line with the findings of (Brackett et al., 2006; Oz et al., 2015)Drawing more attention to interpersonal aspects tells us that despite of the absence of face-to-face contacts in e-learning environments, for instance when leaving a comment under someone's essay in a forum, emotions of the addressee should be considered for the simple reason that words still can kill and they still can cure. Furthermore, the findings can lead us to design more interactive e-learning courses where students are more in touch with each other and interpersonal and interactive aspects of learning are more emphasized.

The findings of the research can lead us to the practical use of EQ in designing more interactive eLearning courses and activities in which students can be more in touch with each other. As an instance, one can use information gap activates which require a great deal of interaction on the side of learners. Controversial topics can also be proposed. In such exercises learners should participate in real-time as well as off line chats to express their opinions and fight for their beliefs and at the same time they should care about the other students' emotions and feelings and eventually the level of EQ will be raised.

Running an EQ test prior to the beginning of the course or having learners fill out forms about themselves and their personality types can help course designers bring such traits and emotional aspects into eLearning. Furthermore, learners should constantly be asked how they feel about the learning process, so teachers and course designers can always be aware of emotional barriers slowing down the process of eLearning as well as the enhancing ones.

Learners should also be taught about the importance of EQ and its aspects; peripheral learning such as using informative photos and messages in contexts like websites, DVDs, TEXT messages or whatever tool is being used in the learning process can be a great help to teach learners indirectly about the importance of EQ. Learners should feel that they are being respected and valued and they should also care about the feelings of other e-classmates.

At the end, it should be mentioned that research can be continued to examine the possible relationships/effects of EQ on the other skills of language such as listening, reading and writing in eLearning. Additionally, more studies seem necessary to be done on the relationship of EQ and acquiring speaking proficiency in other eLearning systems and environments.

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# Distance Learning and the Home Schooling in the Czech Republic

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**Abstract**: Legislation in the Czech Republic like in many other countries allows parents to educate their children at home in the form of 'home schooling'. In this form of education children are taught by their parents. This education is primarily based on the use of printed materials. Electronic materials tend to be used only as supplements to more traditional teaching methods, despite the fact that home schooling is a perfect platform for e-learning. This paper presents a case study of the first school in the Czech Republic that provides distance education in the form of e-learning for Czech and Slovak home schoolers. Children enrolled at this school not only have the chance to use traditional and electronic learning materials, they can also consult on questions and queries with their teachers online. The paper discusses the legislative frame in which this sort of distance learning is set and looks at the different learning methods and techniques, the methods used to assess students, and makes a current evaluation of the whole process. Attention is paid to the e-learning environment and different forms of e-learning support that this school provides to its pupils and their parents. The project presented here in the form of a case study is an innovative example of good practice showing how e-learning and distance learning can be used efficiently with children of primary school age, i.e. an age group among whom distance education is not usual. Distance education is a solution not only for parents interested in home schooling but also for parents of gifted children and children with health disabilities. It enables the provision of centralised support, i.e. one centre can provide teaching to children that are very distant from each other. The school we present here provides e-learning support to about one-quarter of Czech home schoolers. We believe that the practices of the school described in this paper could serve as a good model for other schools in different parts of the world and be a valuable source of information for researchers interested in e-learning aimed at children of primary school age.

**Keywords:** home schooling, individual learning, e-learning, Moodle, elementary school

## 1. Introduction

In the 18$^{th}$, the 19$^{th}$ and the beginning of the 20$^{th}$ century, developed countries adopted laws aimed at the provision of primary education for all children. The laws required municipalities to establish schools and parents to have their children educated, in most cases by having them attend school. The second half of the 20$^{th}$ century witnessed the first demands from some parents to legalize so-called home schooling: education outside of school organized by parents. The fact that children should be educated outside of school and often without trained teachers was perceived as unacceptable by many and as a step backwards. Still, others saw this form of education as the most important positive change in education in the 20$^{th}$ century. Despite much controversy, home schooling has become a legal educational alternative in many developed countries, including the Czech Republic.

Like many other post-communist countries in central Europe, the progress and outcomes of this form of education are monitored by a school. Home schooling is thus a challenge not only to parents but also to schools and their teachers as they must build mechanisms for effectively and suitably monitoring and assessing the progress of children educated at home. In this paper we introduce a school that provides complete e-learning support for its individually educated pupils and their parents.

## 2. Home schooling, basic information

Home schooling is an alternative form of education that differs from alternative and other schools because pupils are educated **at home** for most of the time and their main educators are their own **parents** or people selected by their parents (Petrie, 1995). Petrie (2001) later broadened this definition by adding that home schooling need not just take place at home or close to home and that this form of education may also include such schooling provided in a public space – libraries, museums, community centres, playgrounds etc. The development of ICT naturally has had an impact on home schooling, since it makes it possible to provide education with the help of e-learning, educational TV or radio programmes, internet databases and other information sources. Home schooling cannot be seen as education confined in four walls, isolated from the outside world (Petrie, 2001).

## 2.1 The history of home schooling

The cradle of the modern form of home schooling of the second half of the 20th century is North America, from where this modern and alternative form of education spread to other countries, in most English-speaking ones. It is not surprising that home schooling was evolved in the USA because this form of education existed in the USA for more than two hundred years before the introduction of compulsory schooling. For generations most children were educated mainly by their parents. School was attended (if at all) by older pupils who could already read, write and count. Historical sources provide evidence that home schooling was successful in the USA. For example, Daniel Webster, an American senator, claimed that the outcome of American home schooling was almost 100% literacy in the American population. Webster claimed it was hard to find a fifteen-year-old teenager who could not read and write (Klicka and Harris, 1992). Compulsory school education was introduced in different states of the USA at the turn of the 19th century. Less than fifty years later opposition began to emerge to the school system, and the result was that home schooling was made possible again in all US states by the end of the 20th century. The backlash against compulsory school education also led to an interest in home schooling emerging in countries outside the USA (Kostelecká 2014b).

## 2.2 Forms of home schooling

The legal form of home schooling varies in different countries, including federations such as the USA, Canada or Australia, where different states have very different legislative frames for home schooling. The legislation varies in terms of who can be educated at home and what conditions and criteria parents must meet. In some countries parents have to get special permission, in others they need only inform authorities. Different states and countries differ in how the process of home schooling and its outcomes are monitored and evaluated. The most usual form of assessment is testing by a certified teacher, setting standardised tests, or using portfolio assessment (Jancarik and Jancarikova, 2005). Some states also define the conditions under which the home schooling of a child may continue. Most often the condition is that the quality of education at home corresponds to the quality of education at school or that the child is performing on a level equal to that of pupils educated at school.

### *2.2.1 Home schooling in legislation*

Outside EU countries home schooling is popular in English-speaking countries, namely in the USA, Canada, and Australia. Home schooling is now a legal alternative to compulsory school attendance in all these states. The number of home schoolers has been growing steadily, especially in the USA. According to Ray's estimate (2011), about two million American pupils and K-12 students are educated at home, which is about 3.8% of the population of this age group. There are about 70,000 home schoolers in Canada. A boom in home schooling can be currently observed also in Australia (Harding, 2011). However, like in many other countries, there is a tension between the state and parents with respect to who should bear the responsibility for a child's education – the state or families (Harding and Farrell, 2003).

### *2.2.2 Home schooling in the legislation of selected EU countries*

In EU countries the situation in home schooling is much more complicated. Home schooling is not legal in every EU country. It enjoys the greatest popularity in the UK and France, while it is illegal in Germany, the Netherlands and some Scandinavian countries. In some other countries only a few individuals are educated in this way. In the UK *the parents of every child of compulsory school age shall cause him to receive efficient full time education suitable to his age ability and aptitude, and any special educational needs*. This can be achieved by regular school attendance or otherwise. "*Otherwise*" refers to the right to home educate children at home (Home Education UK, 2000). French legislation is in some respects similar. Education has been compulsory for children from the age of six to fifteen since 1882. The law explicitly states that a child can be educated at a state school, private school or at home by parents or by a person they select. The issue of the legislative frame of home schooling has been discussed by a number of authors - for example Petrie (1993, 1995, 2001), Petrie and Taylor (2000), Kostelecká (2005, 2010, 2012, 2014a), Spiegler (2003).

### *2.2.3 Home schooling legislation in the Czech Republic*

The first calls for home schooling as an alternative to school attendance began to be heard in the Czech Republic as late as 1996 (Kostelecká 2005). Shortly after, on 1 September 1998, the Ministry of Education allowed the home schooling of children of primary-school age as part of an experimental test of this form of education. Home schooling is now regulated by the Education Act introduced on 1 January 2005, which legalizes *"other forms of compulsory education"* including *"individual education without regular school attendance".* Since 2016, home schooling is also legally permitted at the lower secondary school level.

The legislative regulation of home schooling is relatively strict in the Czech Republic. Parents must ask the head of the school that the child is enrolled to for permission. The request form must include the consent of the Education Counselling Institution. The educator must herself have at least an upper secondary level of education (to educate a child at the primary school level) or a university education (to educate a child at the lower secondary school level). Pupil educated individually (at home) must sit and pass an exam organised by the school twice a year. The form this exam takes is not strictly defined in law and is left to the discretion of the school. It may be based on the presentation of a portfolio or may take the form of a test or exam administered in all subjects (Jancarik & Jancarikova, 2005).

### 2.3 Forms of education in home schooling[1]

The fact that the community of families who opt for home schooling vary substantially is reflected in the variety of teaching approaches and methods used in home schooling. Olsen (undated) has identified 23 teaching approaches and methods used in the USA. Most of the methods are based on so called *Classical Education* (trivium, grammar, dialectic and rhetoric period). Another popular model listed by Olsen is *The Principle Approach*. Subjects are taught from a Christian perspective. Another very popular method is *Unit Studies*. This method tries to unite subjects into larger logical units. Yet another popular method is *Living Books*, which has become famous thanks to Charlotte Mason. Mason promotes teaching children through "living books" with engaging plots instead of boring textbooks. The *Literature-Based* method promotes learning through information sources rather than textbooks, which are already interpretations of history and science. Raymond and Dorothy Moore developed the *Moore Formula* method. Education in their approach is practical and non-stressful. Children's interests are a priority, teaching and learning are project-based, children read bibliographies and are involved in family businesses. Many parents of home schoolers use the *Montessori Method*. Parents try to create a rich and stimulating environment for their children. It is also not unusual to use the *Waldorf Method* in home schooling aimed at the holistic development of cognitive, psychical and physical aspects. Many parents do not choose just one method or approach but combine several methods, which is referred to as the *Eclectic Approach*. They may also be developing their own teaching style *Do-It-Yourself*. In some cases children are educated in an approach that reflects the concept of *Unschooling*. Some pupils use several types of *Structured Curricula* in home schooling: *Curriculum in a Box* (a set of all materials for a child's education in a given grade), *Textbooks* (textbooks for home schoolers often include manuals for parents), *Worktexts* (worktexts are often integrated in textbooks), *Workbooks* (designed for practice and revision), CD-ROMs (suitable for children's individual study), Videos/DVDs (more as a support). In addition children can be educated in *Correspondence Schools*, which not only guarantee that state curricula are followed but also continuously assess their pupils. Similar to these are *Online Academies*, which are regarded as a modern version of the *Correspondence Schools.* Some parents of homes schoolers also opt for so-called *Dual Enrolment*, where students at the secondary school level simultaneously attend some courses at a community college. In some cases parents of home schoolers enrol the children in *Umbrella Schools*, schools that are often and private and offer counselling, testing, and also offer elective courses optional courses etc. *Cooperative Learning* is also used in home schooling. This means that parents of home schoolers help each other out. These forms of education can be expected to exist in other countries. A detailed study is not available for the Czech Republic.

## 3. On-line education

As mentioned in the previous section, home education can be provided by an *Online Academy*. These academies are a modern version of the correspondence schools more common in the past. In these schools students use computers to do their homework and complete assignments and to communicate with course instructors. One of the advantages of this form of education is that it provides certificates on having completed a course. This type of support of home schooling is provided in the USA for example by: *Alpha Omega Academy* and *Calvert Online* (Olsen, undated). Parents may use the services of organisations that provide *complete online curricula* or organisations that provide only *support programmes*, and most of curricula is taught in the traditional way. In this case we speak of *blended or hybrid learning*. If children are educated online, their education may be

[1] This chapter draws information from the internet article: Olsen, T. A. B. (undated) The Knowledge House Guide to: Homeschool Methods and Curriculum Options [online]. [cit. 2016]. Available at: http://www.dhch.org/21.homeschool-methods.pdf

*synchronous* (learners must log in at a given time, communicate with classmates and the lecturer and pass exams) or *asynchronous* (learners have more flexibility in fulfilling the assigned tasks) (source of information: http://www.accreditedschoolsonline.org/k-12/online-home-schooling/). Online learning in home schooling is a very rare phenomenon in the Czech Republic. There is only one elementary school that provides and develops this form of support for its pupils, who are primarily-level home schoolers. Online education has been offered by the school since February 2009. The online form of education is highly valued by both home schoolers and their parents. The following text introduces the school and the teaching methods that are used there.

## 4. Březová elementary School – the first school in the Czech Republic to provide individual education supported by e-learning

### 4.1 Description of the school

Březová elementary school is located in the region of Uherské Hradiště, 330 km east of the capital city of Prague. Březová is a small village school near the border with Slovakia. The local school only used to teach children at the primary level and the school was at risk of being closed down as a result of a lack of pupils. The school decided to attract home-educated children. Now it is the only school in this country that offers education using e-learning and online courses at both the primary and the lower secondary school levels.

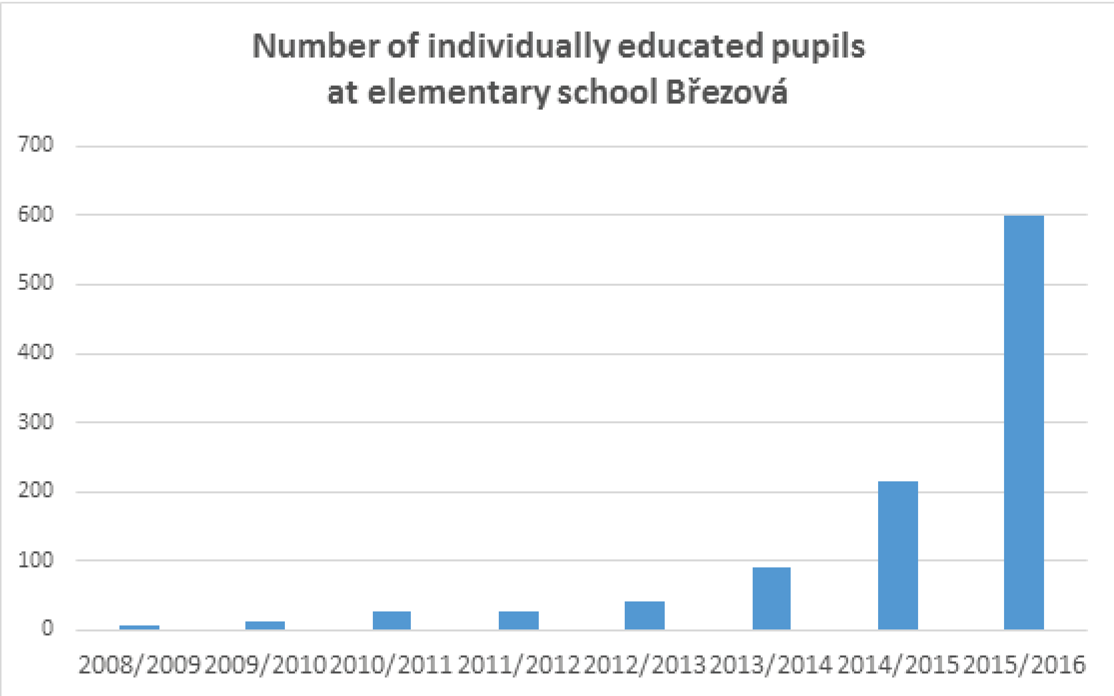


**Figure 1**: Number of individually educated pupils at Březová school

Since the school began offering distance education using information technology, it has never been short of pupils. The figure shows how the number of individually educated pupils enrolled at the school has recently been growing. The capacity of the school had to be increased to 1000 pupils.

The school developed an elaborate model of individualised school education for children. Most of the teaching materials (including videos) are created by teachers at this school.

In addition to traditional educational subjects, education (at both the primary and the lower secondary, including education for special needs children), provides:

- Distance courses for adults who did not complete their lower secondary education and wish to do so,
- Education for Slovak pupils.

The elementary school defined the following objectives of its work:

- To teach pupils to work with a computer.

- To teach pupils to see a computer as a tool for learning.
- Naturally and steadily prepare pupils to do their school work with electronic online support.

The elementary school also has a kindergarten and the same principles are thus also applied at the preschool level of education. This makes it possible for ICT to be used already in the first lessons of the first grade of primary school. Teachers then transfer their experience and use it to support individually educated pupils studying independently.

## 4.2 Pupils

Currently the school has 110 regular pupils and 600 home schoolers from all over the country (see fig. 2). Some pupils even live abroad with their parents (see fig. 3).


**Figure 2:** Map of the permanent residence of Czech and Slovak pupils enrolled in the school

The main reasons the legal guardians of the pupils newly enrolled at the school gave for deciding to start home schooling are the following ([estimates based on the school's data]):

- the child intensively trains in a particular sport (usually tennis) 30%
- the child's talent (music, high IQ) 10%
- bullying at the child's former school 20%
- health reasons (autism, Asperger syndrome) 20%
- dissatisfaction with the child's current school 20%

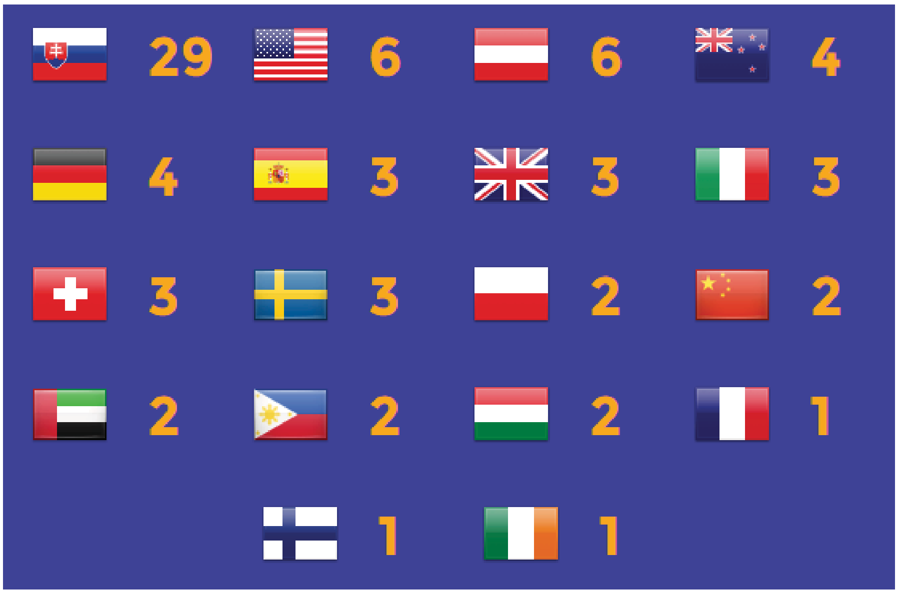


**Figure 3**: Pupils abroad (source – school infographics)

The school developed a model of individualised learning for children in travelling communities (e.g. the children of circus artists, funfair attraction owners), for children who live abroad with their parents, for children with health disabilities, and for other children who for one reason or another have opted for individualised education in the home.

## 4.3 E-learning support offered by the school

At this e-school pupils are provided with learning materials to use but also by on-line support from the teachers. For this reason the school tries to maintain all communication with pupils and their parents in electronic form. Online pupils can find overviews of all the teaching modules in every subject, their assignments, but also information about activities at the school. They can also sit their tests online. Over the past few years the teachers at the school have developed a set of teaching materials and presentations on various topics. What was crucial for developing these materials was that the head of the school had made it clear from the beginning that what they were working on was not just the creation of individualised e-learning curricula for students but a systemic transformation of the school itself. This school's experience demonstrated that such as approach pays off. The use of e-learning allows teachers to do pedagogical work during the lessons and to carry out activities connected to the organization and administration of education using LMS (Learning Management System) at some other time.

### *4.3.1 Learning Management System (LMS)*

*LMS Moodle* is the course management system used by the school. It displays the teaching and learning materials and tests for each course and serves as a platform for communication between teachers and pupils, especially in chat format. Pupils can also take part in discussion forums on different topics or consult on the subject matter with classmates and teachers if they have difficulty understanding it, thus creating a space that is similar to a real classroom situation. Instructions on how to study are provided in emails sent out by the system.

The school uses the following LSM Moodle modules for its needs:

- administration and management of pupils,
- administration and management of courses (in this case subjects),
- management of curricula and plans,
- administration of pupil evaluation,
- online testing and examination of pupils,
- access rights management,
- communication tools,
- tools for development of learning materials (subjects),
- storage of teaching contents.

As well as teachers using LMS Moodle to teach their subjects, LMS Moodle is used to work with talented pupils (it offers extra activities), to work with pupils with individualised education curricula, and for project work outside the classroom. LMS Moodle is also used by the school for creative writing, for the submission of homework and studying at home. Teachers and pupils have an overview of submitted work and its evaluation. All this also develops the pupil's learning skills and computer literacy. The pupil not only creates something, they also learn to use different tools – word processor, spreadsheet and more. The school has also developed and uses a system called *eŽákovka*, which is used for communication between pupils, their parents and teachers. It has several basic functions: *a noticeboard* - communication and chat tools that allow pupils and parents to contact teachers and the school management, *a newsletter* that highlights new announcements on the noticeboard, and a *message tool*.

### *4.3.2 Online learning materials*

After several years the school has now reached a position where LMS Moodle is full of teaching and learning materials, tests, exercises, links to websites for every subject and every grade, which correspond to complete educational programme offered by Březová elementary school (a total of 147 courses). All the support provided through the system takes a similar form, which makes it easier for pupils working in different subjects; the aim is a simple visual interface. All the subjects must follow a simple course structure, and teachers must adhere to the course curriculum, which must include a course outline and content and study materials. The rest is up to the teacher – what materials are offered to pupils and in what format. These auxiliary study tools are developed by the teachers themselves. The underlying idea is that a subject/course developed this way provided good didactical and methodological support for pupils in an individualised study programme (or their educators – parents). It contains a great deal of teaching materials in very different formats. The pupil or their educator then decides which materials to use. That is why the structure is such that all texts, pictures, files and links are located in one place. Teachers develop and administer their subjects. They add various types of teaching and learning materials – from a simple text to flash animations. They create active revision tasks in the form of so-called hot potato tests (with automatic evaluation); and they can use communication and evaluation tools such as surveys. Videos in which teachers explain the subject matter are also very popular. The videos are very similar to those used by Khan Academy. The school's own Youtube channel has more than 110 000 views.


**Figure 4**: Most viewed video – written division (15000+ views)

The potential of LMS Moodle is broad. The teachers decide which forms of support they use. They only have to respect the basic structure of the course. The use of the system also depends on the pupil's age.

### *4.3.3 Online teaching*

Online teaching started to be used by the school in 2014/2015 in some subjects in the 4th and 5th grades and at the lower secondary school level (Czech, Math, Physics, English, History, and Geography). On a given day at a given time pupils studying individually/independently (or also pupils who are ill or absent for some other reason) can use Skype and ask the teacher for permission to connect to a virtual classroom.

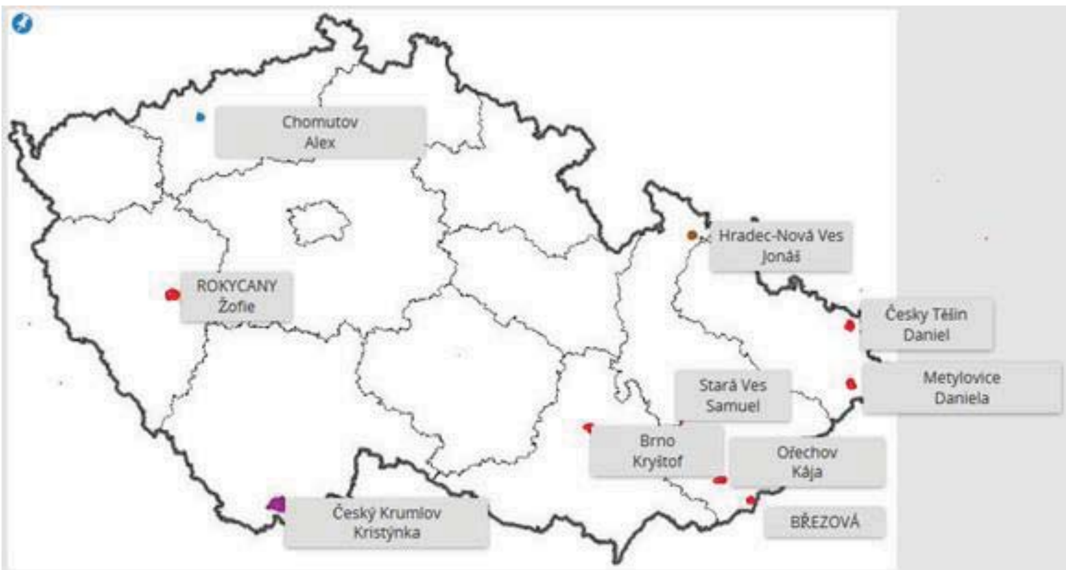


**Figure 5:** Map of places from where pupils log into one of the online lessons

During online learning the teacher projects teaching and learning materials onto a virtual blackboard – pictures, pdf files, Word files and other documents. The teacher can also ask pupils questions and talk to them, send them text messages and share files. Both the teacher and the pupils can write and draw on the virtual blackboard. Everything that is created is displayed to all other participants, who can also join in drawing or writing. The virtual blackboard offers various tools that can be used, but the basic ones are the z virtual pen, pencil, eraser and various geometrical shapes.

#### *4.3.4 Online consultations*

An important part of any form of learning, i.e. also of e-learning, is communication between the teacher and the pupil. That is why the school makes it possible for its pupils to communicate by various different means. Pupils can use mobile phones, land phones, ICQ, email, Skype and so on. It is important for teachers to be available almost all the time.

### 4.4 Pupils' assessment and evaluation

Schools are responsible not only for educating pupils but also for assessing the results of this process. The law requires that schools test individually educated pupils twice a year. Apart from this testing, the Březová school also uses other forms of continuous assessment of pupils' knowledge using LMS Moodle.

#### *4.4.1 Online testing*

Teachers create tests for pupils that can be taken on LMS Moodle. These tests enable automatic checking and evaluation of the test. If this is not possible the test is assessed by the teacher after it is submitted. Currently the courses at this particular school contain more than 1000 online tests and more than 1000 Hot Potato tests. In addition there are almost 300 extra assignments in the system.

#### *4.4.2 Examination*

There is legislation that requires pupils to sit exams in person. This is difficult given the number of pupils enrolled at this school and their distance from the school. This could be a reason some parents might decide not to enrol their child in this school, became it is impossible for the children to travel hundreds of kilometres to sit the examinations. Since January 2015 the school in Březová has consequently also made it possible for pupils to take examinations in its offsite examination centres located in the two largest cities in the Czech Republic (Praha, Brno). In justified cases an examination can also be taken online via Skype. The option of being able to sit exams in other locations in the Czech Republic has increased the interest of some parents of home schoolers in this school.

## 5. Conclusion

The example of the elementary school described above shows that modern technology is a tool that is accessible to and useful for ordinary teachers. Modern information technology bridges distances. After several years of hard work, and thanks to e-learning, a small village school close to the Slovak border has become the national centre of home schooling. A large share of Czech home schoolers are enrolled at this school. Even the most sophisticated technologies are no substitute for real people and not everything can be taught virtually. However, the meaningful use of ICT in the education programme offered by this school is highly valued by both the school's pupils and their parents. E-learning has enabled the school to extend education beyond the confinement of the brick school building; it has made it possible to adapt to and distinguish between the special needs of different pupils; it has made learning and doing homework more interesting and has brought pupils closer to real-life situations. E-learning creates an environment where pupils learn to collaborate with their teachers; they work together on projects and present them to the public. We believe that the example of this small school is a valuable source of inspiration and experience for other schools all around the world and at the same time an interesting object to be studied by researchers in the area of e-learning.

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# Three Levels of Feedback in Adaptive eLearning

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**Abstract:** There is no doubt about the significance of feedback in all human activities. As far as instruction is concerned, feedback is a necessity. In the classic full-time study, feedback is often limited to the evaluation of students' resulting knowledge and skills. Developed e-learning and online instruction expands its possibilities. Through the use of LMS with the possibility to adapt the study material to suit the student's personal characteristics, which also records all of the details concerning the student's behavior during instruction, as many as three levels of automatized feedback can be used (which makes it possible to adapt the entire education process). The first level is the reaction of the system to the student's incorrect answers to control questions during instruction. The second level consists of the final adaptive testing of students. The highest level consists of the analyses of the student's behavior during instruction and the verification of whether or not the adaptation of the study material corresponds to the student's determined characteristics. All three levels can lead to the improvement of the education process. As far as levels 1 and 2 are concerned, the modification lies in the adaptation of guiding the student or the changes in the study material. Level 3 is related to the change of the settings of the student's learning activities or the modification of the process of presenting the adapted study material.

**Keywords:** adaptive instruction, individualized instruction, adaptive LMS, feedback, adaptive loop, student's behavior analysis

## 1. Introduction

At first, we will try to answer the following question: What is the role of feedback in instruction – both classic and e-learning?

Generally, feedback means a process in which a part of a system's output is also its input (e.g. retroactively influences its other actions). During the course of the process, information about an ongoing process is being collected and evaluated. The input is then modified on the basis of the results.

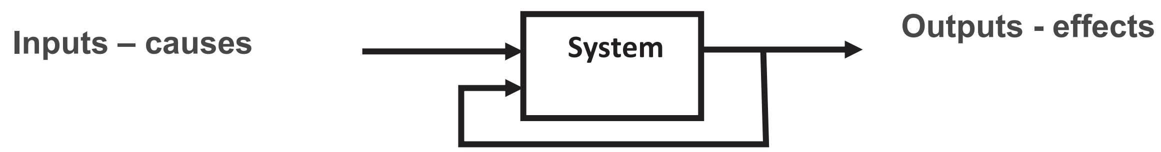


**Figure 1:** Feedback cycle

Anything can be a system. In nature, every plant, animal and human is a system. From birth, they learn to walk, talk, etc. through constant and repeated attempts. When not successful, they correct their behavior in order to achieve a better result. When successful, however, they repeat the strategy in order to develop further. Without knowing the term feedback, they subconsciously apply it. Feedback is the cause of all development, be it a conscious or an unconscious one.

However, it applies not only in nature. Feedback is also used in artificial systems created by man. Sometimes only subconsciously, when one is solving a problem or creating something by trial and error. Feedback is deliberately used in technical, economic, natural history and social sciences. For instance, opinion polls can serve as a typical and simple example – based on the results, a submitter (usually a politician) corrects their behavior in order to comply with the public opinion and to achieve better results in the following poll.

As far as instruction is concerned, feedback is a necessity. From the initially spontaneous and natural activity, learning becomes a managed process. In the process, the student needs to be taught new knowledge and skills, about the existence of which they do not need to know, but which they will need in their professional or personal lives.

## 2. Adaptive e-learning instruction

Until recently, student-tailored, personalized instruction was rare and took place only in artistic fields, sports schools, etc. In regular schools, it could not be implemented because of the large number of students per teacher. Moreover, all the students had the same textbooks. It was mainly because the issue of adaptability of the education process to the student's personality had not been explored yet. At the University of Ostrava, a team of experts (pedagogues, psychologists and informaticians) started working on this issue in the e-learning environment and created a general model of adaptive instruction (Kostolányová, 2012). The main goal of this model is the creation of a personalized study material which reflects the student's most preferred learning style. The general model of adaptive instruction can be seen in Figure 2:

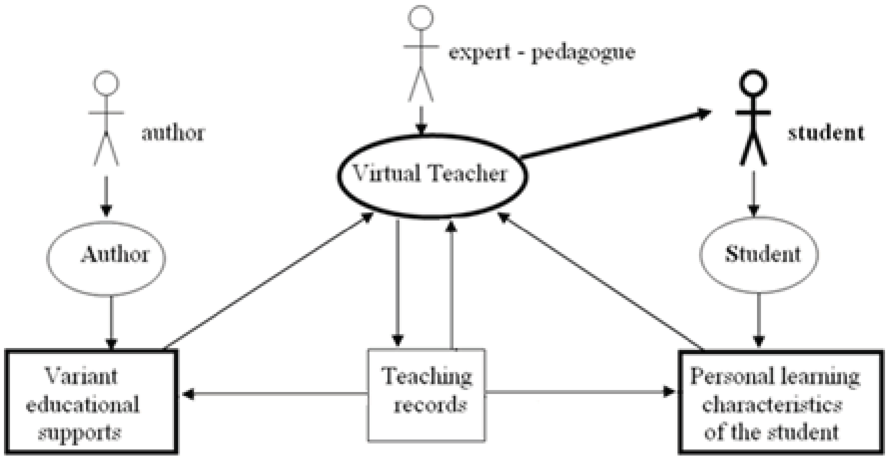


**Figure 2:** General model of adaptive e-learning instruction

The LMS is divided into the following modules: Student (identification of initial student characteristics), Author (inserting and modification of study materials) and Virtual Teacher (adaptive algorithms included in the expert system and a system for data analysis). If the program that manages individualized instruction is to manage it in an individualized manner, it needs to know a number of information regarding the student's learning style (the Student module). A number of experts focus on learning styles in their work. Based on various criteria, those have defined a number of student characteristics influencing the learning style (LS). Based on an analysis of these characteristics, a tuple of mutually independent characteristics determining the student's learning style was defined. Those can be applied in e-learning (Kostolányová, Šarmanová, Takács, 2009).

When it comes to adaptability, another question arises: How does a textbook have to be compiled to be adaptable to every student's learning style? The curriculum is processed in four sensory variants (different "active" words and types of multimedia need to be used) and three depths of instruction. As a result, there are 4x3=12 variants of instruction. The remaining characteristics are approached in a different manner. The curriculum is divided into chapters and units. The units gradually introduce new information and terms. We named the unit of such information a frame. The variants of the study material differ mainly in sequence and the selection of individual parts inside the frame. That is why rules on how to choose and organize (i.e. adapt) the individual parts of the study material to suit the student's learning style have been formulated. As a result, each frame has been divided into parts called layers. The following layers have been defined: instructional (theoretical, semantic, fixation, of solved examples and of practical examples), testing (theoretical questions, tasks and practical tasks) and special (motivational, navigational, formulation of goals, literature). These layers have turned out to be in accordance with didactic principles, Gagné's theory of education process and other pedagogical-psychological principles.

We named the program managing instruction the Virtual Teacher (VT). Based on the author study material structured into frames, variants and layers, the VT's task is to create an optimal version of the study material for the current student defined by their LS characteristics. The entire process is divided into two phases.

In the first phase, the VT defines the current student's optimal educational style (OES), i.e. for every frame, it compiles a theoretically optimal selection and sequence of layers valid for any study material. However, the actual study material does not have to contain all the variants and layers for every frame (see the end of Paragraph 1.2.).

That is why we need Phase 2. Once again, for every current frame the VT does the following: based on the student's OES defines the so-called actual educational style (AES) where the adaptation of the frame is based on a real frame. The missing variants and layers are replaced with the closest ones or omitted altogether.

## 3. Feedback in adaptive instruction

In the classic full-time study, feedback is often limited to the evaluation of students' resulting knowledge and skills. The teacher cannot record all the continuous information about their students' knowledge, behavior and opinions. Therefore, they use only their pedagogical and personal experience for modifying their teaching methods.

Developed e-learning and online instruction expands the possibilities of feedback. Through the use of LMS with the possibility to adapt the study material to suit the student's personal characteristics, which also records all of the details concerning the student's behavior during instruction, as many as three levels of automatized feedback can be used (which makes it possible to adapt the entire education process) (Drápela, 2013; Takács, 2014).

- The first level is the reaction of the system to the student's incorrect answers to control questions during instruction. The appropriately used feedback verifies whether or not students pay attention during the course of instruction and their understanding of the discussed curriculum.
- The second level consists of the continuous (unit) or final (entire subject) adaptive testing of students; it is testing the main goal of instruction – students' resulting knowledge and skills.
- The highest level consists of the analyses of the student's behavior during instruction and the verification of whether or not the adaptation of the study material corresponds to the student's determined characteristics.

All three levels can lead to the improvement of the education process, both on the part of the student and the teacher – the author of the study material or the Virtual Teacher that manages adaptive instruction.

Feedback provides the student with information about their knowledge and thus influences their future learning endeavors. As far as the teacher is concerned, the regular, targeted and formative information leads to the improvement of their work and can reveal didactic errors in the study material or the rules that manage instruction.

The entire education process is perceived as a system with the following characteristics:

- Input includes:
- *Study materials,*
- *Students with their learning characteristics,*
- *Student's initial knowledge and skills,*
- *Rules which the Virtual Teacher follows when adapting the study material to the student.*
- System represents the actual instruction in one of the instruction modes:
- *First reading without feedback,*
- *Actual online instruction with partial control questions,*
- *Comprehensive revision of the discussed curriculum (including the explanation of the problematic parts),*
- *Self-testing as a preparation for the actual examination,*
- *Testing the resulting knowledge and skills.*
- Output includes:
- *Student's partial answers during the course of instruction or revision and their correctness (**in more detail in 3.1.**),*

- *Results of self-tests and tests (**in more detail in 3.2.**),*
- *Detailed records of the student's behavior during the course of instruction (**in more detail in 3.3.**).*

All three types of results are used as feedback. Let's look at them in more detail.

## 3.1 Immediate reaction to student's error

Feedback between the teacher (in this case, the Virtual Teacher) and the student should be implemented into every lesson. As far as adaptive e-learning supported by the adaptive LMS is concerned, the study material is divided into units (lessons). Lessons are further divided into frames (elementary units of new information). Frames are processed in various sensory variants corresponding to the types of human sensory perception, and in various depths corresponding to the different levels of the student's "understanding" distinguishable according to the success rate of the answers to control questions. Every frame variant is divided into the so-called layers, i.e. homogenous parts of instruction corresponding, for example, to Gagné's stages of instruction. There are instructional layers (theoretical – definitions of terms, semantic – explanation, fixation – revision and incorporation of new terms to the knowledge structure, of solved and practical examples), testing layers, i.e. feedback (theoretical questions, application tasks and practical tasks) and special layers (motivational, navigational, etc.) (Kostolányová, 2012).

Every frame can contain a number of questions and tasks. Those are to verify the student's correct understanding of the curriculum and the acquisition of new skills. The student immediately learns if their answer is correct (the partial result), the Virtual Teacher reacts to the answer (the lowest level of feedback) and the answer is recorded for the subsequent global evaluation.

The use of positive feedback is one of the important rules in the reaction of the system to the student's answer. If the student answers correctly, the system is supposed to give them praise. Moreover, the form of the praise should vary (e.g. randomly generated from the list of formulations) in order for the communication between the system and the student to be more natural.

If the student answers incorrectly, it is important not to discourage them. It is important to encourage them and motivate them to try again. For this very purpose, the following algorithm has been developed in the adaptive LMS (Prextová, 2014).

Algorithm of the Virtual Teacher's reaction to the student's repeated incorrect answers:

- If the answer is incorrect the first time, notify the student of the incorrectness of the answer and ask them to try again. It represents the situation when the student makes a mistake and realizes the mistake (or the mouse overclicking) when notified of it.
- If the answer is incorrect the second time, publish "Reaction", recorded by the author of the study material (a special part of this testing layer which offers the student help in the context of the question); if "Reaction" does not exist, proceed to the following step. It represents the situation when the student makes a foreseeable mistake and the author of the study material intends to react to it in a specific manner.
- If the answer is incorrect the third time, return the student to the "Reference" layer with the particular information (an instructional layer or a layer with an example of the task solving). If "Reference" does not exist, proceed to the following step. The author of the study material decides which layer is the "Reference" one. It represents the situation when the help is not enough and the student has to return to a particular part of instruction. The student does not need to look for it themselves, it is offered to them. The student is encouraged to try again.
- If the answer is incorrect the fourth time, the system shows the student the complete correct answer or the solution of the task including the explanation. The author inserts the complete correct answer in the "Help" layer as part of the question. If "Help" does not exist, only the correct result is displayed. The student is encouraged to try again and only copies the result.

The student eventually answers every question correctly, even if they only copy the result. This way they better remember the result. The author can assign an entire group of the so-called equivalent questions and the system records which questions the student answered correctly and which incorrectly. As a result, not the identical questions but the modified, equivalent ones are offered to the student. When solving the application tasks, the student practices their theoretical knowledge and skills; it is not enough to only memorize the correct answer.

## 3.2 Adaptive testing as preparation for exam

During the course of instruction, the curriculum needs to be revised in order for students to remember it in the future. In the classic instruction, independent tests taken by students after larger units or at the end of the course are used for this purpose. Naturally, students should have a tool at their disposal through which they could revise and verify their knowledge before the actual testing.

For this purpose, the adaptive LMS offers two modes (Prextová, 2014).

The Revision mode is based on an adaptive presentation of questions and tasks of different difficulty to the student. Both theoretical and application tasks are assembled into a "matrix", vertically – a number of difficulty levels, horizontally – the curriculum of the tested subject. If the student answers correctly, they are presented with more difficult tasks. If the student answers incorrectly, they are presented with less difficult questions and the abovementioned 4-level help with the reference to the particular part of the curriculum. However, all of the tasks are in accordance with the required level of knowledge.

The author of the study material can set a number of parameters for every test in their course:

- Set the number of difficulty levels of tasks,
- For every "obligatory" task, the author can include a group of equivalent tasks,
- For every task, the author can include Reaction, Reference and Help (see Chapter 2),
- Set a relationship between the level of difficulty and the speed of its change.

If those parameters are not set by the author, the values implicitly set by the system will be used.

The student goes through all of the tasks of a unit or subject in a horizontal manner, and – based on their reactions – through the particular levels of units/the subject. At the end of the test, it is evaluated at which level the student answered the majority of questions, which determines the student's current level of knowledge (and also the grade).

The so-called equivalent questions are used. In order for the student not to be presented with the identical questions and tasks when repeatedly going through the course in the Revision and Self-testing modes, the author of the study material can create and insert into the system a group of questions instead of only one (in the metadata, those questions constitute a group). Therefore, when the student answers any of the questions correctly the first time, the next time they will not be presented with the identical question but with one of the equivalent questions. The equivalent questions differ in the formulation of facts, numerical specification in mathematics or physics, the use of sentences for the description of the identical grammar phenomenon in language instruction, etc.

There are individual records of every student's personal characteristics, but also of the entire course of instruction – it is recorded which units, frames and layers the student has taken, which testing layers they successfully completed, how many times, etc.

Self-testing is another mode offered by the adaptive LMS. The self-test is an independent verification of students' knowledge and skills, this time with no help and in a set time. This stimulates the so-called actual testing. The only difference is that only the student can see an automatically evaluated result, including correct and incorrect answers and point assessment. The student can run such a self-test multiple times until they are satisfied with their knowledge. Practical experience shows that this tool is very popular during the exam period.

## 3.3 Long-term monitoring of students' performance

In the adaptive LMS, every student's education process is recorded. Every mouse click is recorded, when the student moves to the following layer, when the student changes the recommended educational sequence, the student's every answer, etc. Comprehensive data are recorded through the analysis of which feedback on instruction can be acquired.

The education process is recorded into two charts. The first chart with 38 attributes records the student's actions (mouse clicks), i.e. the student's personality, subject, the action conducted and the circumstances of the action, the student's behavior and knowledge. The second chart with 15 attributes records details concerning the individual answers of testing layers. Firstly, for the purpose of the analyses, the data acquired from the basic identifiers need to be preprocessed: all the other layer attributes of the subject and the student need to be added, the time spent on every layer needs to be calculated, a number of attributes need to be categorized and the number of deduced attributes needs to be calculated. The calculation is time consuming; the result again being 2 charts with 69 and 41 attributes, respectively.

For the purpose of the author's initial preview of the instruction data, the basic statistical characteristics of all the attributes are calculated: frequency, domain scope, average and median. These values offer useful information about the number of students who took the course, the number, length and sequence of students' sessions, the time students spent on educational layers, the scope of students' manual interference with the management of instruction, students' learning style characteristics, the types of layers presented to students, learning style characteristics of the layers, the types of testing layers (questions), students' success rate for the individual testing questions, the number of answers to questions, the correctness of students' answers, etc.

The statistics of the Business English course can serve as an example (Horký, 2014):

- 277 students in 2099 sessions (logging in the system) attended the course, which translates into 1 – 35 sessions per one student (predominantly 4 sessions), the time of studying was mainly Wednesday around 4 p.m.
- Students completed 45 instructional and 29 testing layers on which they spent 1 – 1,200 seconds (too much time probably means that the student has automatically logged out from the system).

The analysis of the education process is conducted from three main points of view:

- From the point of view of the quality of the study material,
- From the point of view of the student's learning style characteristics,
- From the point of view of the rules managing the education process.

Methods of acquiring knowledge from data, particularly finding associations and methods of construction of the decision tree could be used. Those can find all the combinations of attributes – potential causes, which result in different values of attributes, i.e. consequences. This can result in the occurrence of not only the expected relations between attributes, but also of hypotheses – associations between attributes – which no one thought of exploring yet. The newly found associations are hypotheses which can be systematically examined.

Every relation is formulated as a rule of the IF – THEN type where IF is a cause in the form of elementary conjunction of cause attributes and THEN is a consequence, i.e. the value of a particular attribute. The reliability is the percentage of valid cases (fulfilling both cause and effect) of the cases fulfilling the cause. The support is the number of cases fulfilling the entire association.

## 4. The analysis of the education process

Overall, the following have been determined: three types of analysis related to providing feedback to the author of the study material (evaluation of the study material), an analysis for the verification of the correctness of the student's learning characteristics (adaptation of the student's learning characteristics) and the information for the learning management system (the Virtual Teacher feedback).

### 4.1 Evaluation of study material

The first type of the analysis provides the author with the information about the effectiveness of instruction from the point of view of the correctness of the author study material (Dvořáčková, 2016). It is evaluation of the course study material based on the monitoring of a number of actually completed educational processes. Not only opinions and feelings of students from the evaluation questionnaire are being analyzed, but also their real behavior during the course of instruction. The analyses assume that the characteristics of all students are correctly set and the educational rules are correctly formulated. It is aimed at specifying the parts of the study material that are either unsuccessful in general, or for particular types of students.

The analyses aim to answer 3 main questions:

- Under what circumstances (values of attributes which may be the cause) do students achieve different levels of knowledge?
- Under what circumstances do students spend a different amount of time on individual parts of the study material?
- Under what circumstances do students find the offered instruction insufficient and search for other variants?

The causes are attributes characterizing the study material, the student's personality, the action and its circumstances.

The already mentioned 3 attributes are the consequences of the wanted hypotheses: the level of students' knowledge, the time spent on individual layers and the sign of a manual switchover of the student.

Example: During the evaluation analysis in the Business English course, a number of associations were found some of which were expected. However, also a number of interesting relations were found.

Out of the 267 resulting associations, we will list a concise summary representing the most important and most general ones.

- Officially the result is presented as follows:

skin=(76-100) → proc=0, podp=30, spol=85%

Verbal interpretation of this rule:

Highly (76-100) kinaesthetic student (skin) has a zero knowledge result (proc=0) in 85% of cases, which is in 30 cases.

More detailed interpretation of this rule:

The textbook is not suitable for kinaesthetic students; it either does not contain the kinaesthetic variants which are replaced by the less suitable ones, or are not created correctly for kinaesthetic students (statistical data show that the kinaesthetic variants do exist but do not cover all frames).

As far as other results are concerned, we will present only their interpretations:

- If the depth=1 (the variant for advanced students with high success rates), the knowledge result is zero in 9 cases, which is 75% of cases. Therefore, testing layers in depth 1 are too difficult for successful students of all types.
- If a type of question=created (open question without any offered variants of answers), the knowledge result is zero in 24 cases, which is 80% of cases. Therefore, open questions are less successful than closed questions.
- If the number of offered variants of answers is high (>5), then the time spent on the question is (0-2 seconds). Therefore, students do not read the offered variants if there are too many of them.

We will present one more result as an example of the detailed evaluation of individual questions:

- If an ID_Tlayer=TVrs000024, the knowledge result is zero in 20 cases, which is 80% of cases. When the question is answered incorrectly in 80% of cases, the problem lies either in previous instruction or in an incorrect formulation of the question.

## 4.2 Adaptation of student's learning characteristics

The second type of analysis is the verification of the student's learning characteristics. There are 14 such characteristics (Kostolányová, Šarmanová, Takács, 2009): 4 types of sensory perception, social and affective aspect, learning tactics including orderliness, the method (the theoretician, the experimentalist) and the technique (the stickler for detail, the holist) of information processing, the approach to study, the degree of self-regulation and the success rate. Apart from the last one, all of the remaining attributes are being determined through a special questionnaire which the student fills out when they log in the LMS for the first time. The last dynamic attribute, success rate, is set to "average" at the beginning and – during the course of instruction – is automatically updated according to the correctness of answers to the partial questions – see Chapters 2 and 3.

The qualities determined by the questionnaire may not be reliable and yet they are the basis for the Virtual Teacher's adaptation of the study material to every student. The reasons are as follows: the questionnaire reflects the student's opinions of themselves; the student's qualities can change over time.

Therefore, the course of instruction of every student is being analyzed from the point of view of their behavior: how many times and how frequently they studied, how long, with what results, whether or not they were satisfied with the study material, whether or not their results improved over time, etc. The protocol offers a selected student's results from all subjects.

Again, the basic statistical characteristics of the attributes are calculated. Moreover, a timeline of the student's studying is calculated from which the individual characteristics of their learning style are derived. The results are compared to the characteristics stored in the student database. In the case of a significant difference between the calculated and stored value of any quality, the value is automatically updated.

The issue of how to determine the values of the student's learning characteristics from their behavior has not been addressed yet. However, it is the topic of one of the upcoming dissertations. The aim is to find answers to the following questions and to assign correct values of the individual qualities to the results.

The current student learns in the following manners:

- Systematically, throughout the entire course of instruction – a moment before the exam;
- Step by step throughout the entire course – switches between subjects, units, frames;
- Gradually goes through all the modes including revision and self-tests, how many times;
- They are satisfied with the variants offered by the system – often exchanges variants, for which ones;
- How much time they spend on individual layers, on which ones do they spend a long time – a short time, of which:
- *Time spent on the instructional layers – theoretical and others according to the type,*
- *Time spent on the testing layers – according to the type,*
- *Time spent on the special layers – according to the type,*
- Systematically answers the questions – only reads the correct answers;
- Their answers are gradually improving with every mode – their answers are not improving;
- There is a difference between the results of theoretical questions – application tasks – practical tasks;
- There is a difference between the results of closed – open answers.

Eventually, the associations for finding possible new hypotheses (this time valid only for individual students) are calculated. Causes and effects are set similarly to the analyses of textbooks (see Chapter 4.1).

### 4.3 Feedback for virtual teacher

The third type of analysis is the verification of the correctness of pedagogical and other rules according to which the Virtual Teacher adapts the study material to the student. Some of the results from previous analyses can be used for this purpose. Until now, those rules were formulated only on the basis of pedagogical knowledge and experience of the authors of adaptive instruction.

The Virtual Teacher subsystem, which enables a simple modification or addition of the rules without programmer intervention, is incorporated into the adaptive LMS.

Adaptation of instruction can differ with the educational content. For instance, the instruction of the English language can be adapted differently than the instruction of mathematics or psychology. Moreover, pedagogical experiments, which verify the efficiency of different types of adaptive instruction, can be conducted in the system. Generally, only part of the rules for the adaptation of instruction needs to be modified, the remaining rules can be used in their original form. Therefore, the rules are divided into the following levels (Takács, 2014):

- Level: general rules which are used in all subjects and reflect the basic pedagogical principles.
- Level: rules for a group of subjects, e.g. a study program. These rules are used in all subjects of this group. These rules conduct adaptation specific to a particular curriculum – adaptation of foreign language teaching, mathematics and history may be different.
- Level: rules for a particular subject.
- Level: rules for a group of frames, e.g. a unit or a chapter. These rules are used in all frames of the particular group.
- Level: rules for a particular frame, variant or layer.
- Level: rules for a group of particular students, e.g. a classroom.
- Level: rules for a particular student.

The current version of the rules contains only Level 1 and 3 rules for Business English.

How to determine correctly and incorrectly defined rules from the instruction protocol is another issue that is yet to be addressed. However, the members of a team focusing on further development of the theory of adaptive education are dealing with the issue.

## 5. Conclusion

At the Department of Information and Communication Technologies of the Pedagogical Faculty of the University of Ostrava, a team of pedagogues and Ph.D. students has been developing the theory and implementation of adaptive e-learning instruction for a number of years now. Within the scope of this research, the LMS, which supports the theory, has been developed and realized. LMS made it possible to conduct a number of pedagogical experiments which verified the validity of various rules of individualized instruction.

The detailed recording of students' behavior during the course of instruction is an important feature of the LMS. It provides comprehensive data which enable detailed and previously unrealizable feedback to students, the authors of study materials as well as the authors of the theory.

As far as the student is concerned, the first two types of feedback are an immediate adaptive loop during the learning process and long-term feedback in the Revision mode. It is helpful and motivating and actively helps the student become acquainted with the curriculum.

The third type of feedback is intended for teachers, both real and virtual. The results of the evaluation of the study material inform the authors of study materials about possible questionable parts in the textbook which can lead to the collective misinterpretation of the curriculum. It draws attention to incomplete or inappropriate formulations in instruction, and wrongly formulated or highlighted questions. The results are valuable feedback for the authors of adaptive study materials.

It is difficult to discuss the findings of the theory, which is still being verified in practice. If we are to compare incomparable issues, we would like to mention the research activity of P. Brusilovsky who also deals with the creation and evaluation of adaptive study materials (Weber & Brusilovsky). In practice, he focuses on the creation and testing of an interactive adaptive textbook on programming. He creates an open system which he gradually expands by other functionalities such as adaptive tutoring (problematic curriculum) or adaptive ways of navigation within the created study material.

Another system that is being verified in practice is ARTHUR by Gilbert and Han (Gilbert & Han, 1999). In this system, the course is divided into frames which come in several variants. Each of the variants is created by a different author, i.e. each of them is written in a different style. At the beginning, the student is assigned a variant in a random manner. On the basis of results the student achieved in the variant, students who had similar results in previous frames are selected. Moreover, the frames in which previous "similar" students achieved the best results are selected. This way, the majority of students with particular learning styles eventually choose variants created by the teacher whose teaching style suit them the most. Another system, which is being tested mainly at universities, is the adaptive, personally-tailored system GALE which should prevent study failures (Smits & De Bra, 2011). All of the adaptive environments are being developed. Their verification in practice is difficult and slow. However, in all cases partial results have been presented.

The proposed theory of adaptive e-learning (Kostolányová, 2012) and its gradual implementation into instruction, as well as the creation of evaluation and control feedback mechanisms, is the subject of further academic research, mostly in the academic papers of the Ph.D. students studying in the study program aimed at the implementation of ICT into education.

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# Opportunities and Boundaries of Heuristic Strategies Through e-Learning

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**Abstract:** Our contribution covers a case study of five mathematics teacher-trainees who have participated in an LMS Moodle e-learning course, which focused on the development of selected heuristic strategies – Use of false assumption, Systematic experimentation and Introduction of an auxiliary element. The study describes the opportunities of heuristic strategies and adherent phenomena aimed at didactic competence of future mathematics teachers in the LMS Moodle environment with the use of devices of social learning, while we mainly observed the changes where thus designed teaching varies from common – contact teaching. The entire course has been drawn into three main activities: adopting heuristic strategies through problem solving; problem posing; and reflecting their sensitivity to using heuristic strategies in solving tasks with their pupils in their own pedagogical training at schools. These activities were realised with the help of classic instruments of Moodle courses – individual work, providing feedback and discussion. One of the results was finding which heuristic strategies the students had mastered before the beginning of experimental teaching, which they acquired in classes and which gave them trouble. The research has also shown that in cases of individual students we may trace certain dependence between the quality of tasks formulated by the students and the quality of feedback provided. Among other issues, the article discusses a potential influence on the sensitivity to using heuristic strategies while solving tasks with their pupils, deduced from the proceedings of the electronic discussions and further from semi-structured interviews, which took place after the teaching process had been completed.

**Keywords:** heuristic strategy, mathematical problem solving, social learning, didactic competence, teacher training, LMS Moodle

## 1. Introduction

Every teacher of mathematics should provide tools to incite a pupil´s interest for their field. A suitable way to reach that target is to convince the pupils that they are able to become mathematical thinkers. To make it possible for the teacher to convey that to the pupil, the teacher must identify themselves as a mathematical thinker. Owens (2007/2008, p. 49) says that "The discussion shows that identity as a mathematical thinker arose from a combination of learning experiences, social interactions and technological supports.", where all his study has been based on problem-solving.

Acquiring heuristic strategies (HS) is considered one of the key skills of the mathematics problems solver. In many cases the pupils may not have all the needed tools to solve unfamiliar problems and this is when they can employ HS. HS are perceived here in the sense of Polya´s (2004) and Schoenfeld´s (1985) views. We propose, that to a certain extent, pupils can be taught to use some HS in problem solving and thus solve problems efficiently; hence a course focusing on the development of the teachers´ particular solving and didactics competences has been scheduled for teacher-trainees at the University of J. E. Purkyně.

Seeing that the number of students in distance education increase and that we feel a need to provide an opportunity for such practical teachers´ education in terms of in-service training of teachers (ISTT), we started to consider an e-learning course. This format is compliant also in the light of the need of long-term operation. At both acquiring HS as well as developing particular didactic competences it is necessary for the potential attendee to solve a large scale of problems, to compare various results, to look for relations, formulate generalities and differences and so on, and all that desires time. But that in the case of ISTT is an organization problem.

That is why we have designed an e-learning course focused on the development of solving and didactic competences intended for the teacher-trainees, and it will be aimed at three particular HS – Systematic experimentation, Use of false assumption and Introduction of an auxiliary element (For more details, seeNovotná, Eisenmann and Přibyl, 2015.) Together with the experiment we have created a methodology to be able to, through the case study, describe the options and obstacles of e-learning teaching of thus aimed e-course, and that understandably in comparison to traditional contact teaching.

## 2. Theoretical background

Part-time teacher trainees´ education is an option of how to, in terms of (pre-service and in-service) teacher training, increase their qualification. Such option is approached in cases of distance or time-consumption reasons that don´t allow them to take part in classes directly (Perraton, 2002). We have been focused on pre-service teacher training as within the frame of university studies, students can opt for a distance form of study. We have decided to blended learning supported by LMS Moodle from the large scale of offers mentioned by Burns (2011) as it has been found fruitful in teacher training on long-term basis, according to e.g. Miranowitz (2009). The blended learning style combines face-to-face and technology-based learning and instruction. As it has been mentioned by a whole number of authors, nowadays such way of teaching becomes a necessity within the university curricula (e.g. Jing et al, 2015).

Our paper deals with the following three HS.

- *Systematic experimentation* (SE) belongs to the family of experimental strategies. The solver starts by selecting some value and then works systematically.
- The basic idea of *Introduction of an auxiliary element* (IAE) is that the introduction of an auxiliary element makes the solution much more easily accessible to the solver. In case of geometrical problems, this will commonly be a straight line, a line segment, a point or a figure; in case of arithmetical or algebraic problems it will be a number or a function (Eisenmann, Novotná and Přibyl, 2015).
- *Use of false assumption* (UFA) has – in comparison to the two above mentioned – its own specifics. It is not a means to solving a problem only, but mainly is a convenient propaedeutics to the elementary algebra, where the mathematical background of this strategy is a linear function.

## 3. Experiment process and results

The existing research into acquiring HS has always followed the success rate of developing solving skills through face-to-face teaching. We therefore face the question if and how it would be possible to acquire HS through e-learning. The case study placed within the above described e-learning course should answer the following research questions:

*RQ1. Will students acquire all examined heuristic strategies due to the e-course?*

We use three tools to evaluate how students master a particular HS: 1. evaluation of the initial and final tests, 2. evaluation of problem solutions without a HS given and 3. analysis of problems formulated by the students with the target of illustrating individual HS best.

The last among the tools is related to the following question set in terms of the case study – the teacher to be (as well as a practicing teacher, understandably) needs not only to master HS as a solver but needs to have adequate didactic competences necessary for successful teaching of examined HS at hand, by which we understand mainly the ability to see in what situations it is adequate to give the students an incentive to use a particular HS. That is why we have focused also on the following question:

*RQ2. Will students acquire adequate didactic competences necessary for successful use of examined HS in teaching due to the e-course?*

This question is answered with the help of two tools: 1. evaluation of commentaries in the discussion forum aimed at qualified observation of teaching in teaching practice and 2. evaluation of semi-structured interview with students realized after the completion of the course. The phenomena observed during discussion forum and face-to-face discussion will be compared.

### 3.1 Description of observed sample and course realization

The observed sample covered five students of mathematics education in their semi-final year of their study at university within the frame of LMS Moodle course, focused on the development of three HS. One student has not provided all of the data. The course lasted for 9 weeks and was divided into several parts with partial mutual penetration:

- The initial part consisting of students´ filling in forms on their attitude to e-learning and further sitting for the initial test comprised of three standard tasks, where each was aimed at a particular HS examined. Consequently, the students had sample solutions of individual tasks at their command.
- The study part where the students had its description at hand and solved problems to each HS. Then they were to solve individually for each HS three problems, meaning they knew the recommended HS. Again, they consequently had sample solutions at their command, where with the exposition of various phenomena were also some of their procedures used.
- The solver´s part with 7 problems designed to be solved by students on their own without a HS recommended. They later evaluated selected solutions of their colleagues´ according to criteria given (correctness of solution, use of HS, comparison to an own or other solution). Again, they were given sample solution.
- In the author´s part where they were to formulate their own task, to solve their colleagues´ tasks and consequently evaluate the solutions of their colleagues´.
- Discussion part where they were to discuss the two major topics – the usefulness and the gains of the HS studied and particular didactic situations which (even though potentially) refer to HS in their teaching practice.
- The final part includes sitting for a final test comparable to the initial one.

With the help of a simple multiple choice questionnaire we were investigating into the students´ experience and attitudes to e-learning. In all observed cases the students voted for attending the complete e-learning course, in reference to their own IT usage experience. None of the students involved had had a direct experience in any e-learning, but they had great expectations, mainly acknowledged the option of self-directing.

## 3.2 Acquiring three examined HS

### *3.2.1 Initial and final tests*

The initial test comprised of three mathematics problems where each aimed at one of the HS studied, but the solvers were neither given the information nor did they receive an instruction to use some HS. The difficulty of the tasks agreed with 11–15 years old pupils, so we expected the students to have no difficulties in solving them; but we were keen to see if they would spontaneously use some HS. In more or less all cases the students were able to solve the tasks, but the use of HS varied. We compared the results with the results gained in analogically composed final test sat for at the end of the entire course. The conditions to work in it were the same as with the initial test. All students used required HS in their solutions in the final test. Table 1 summarizes effective occurrence of HS and success rate of solutions with individual tasks.

With the initial test, the students spontaneously used only IAE, in the cases of SE and UFA thy solved tasks directly with the use of algebra knowledge (concerning the use of the criteria of divisibility by number 11 (SE) and the composition of an equation (UFA)). On the contrary, in the case of the final test all students were able to use an adequate HS efficiently.

### *3.2.2 Phase of solving*

The previous data needs to be interpreted in relation to the next part of the research where the students were provided with 7 problems (2SE/2UFA/3IAE) with no HS recommended in accidental order. We always observed the use of HS with the students´ solution within all strategies. Moreover, we observed specific features with individual strategies:

- With SE it was (a) the use of Excel or other spreadsheet; and (b) exploitation of all options of experimenting (with Diophantine problem), or adequate completion of the experiment (in cases where the value searched was not limited by the problem context).
- With UFA we observed (a) choices of false assumption (FA); and (b) calculations through equations.
- With UFA we observed (a) choices of the auxiliary element (AE); and (b) if based on it the problem was re-formulated.

In the case of SE all students used an observed HS and commented on it adequately. Three out of five students used Excel, two did manual calculations. The students always either went through all options or ended the experiment appropriately, but with no reasoning given.

In the case of UFA all students adequately used HS and commented on the procedure moderately. With the choice of FA, strategies differentiation in quality appeared, and were later used in the discussion about adequate solution procedures in the next part of the course.

In the case of IAE the results are dependent on individual problems; that is why it is necessary to give brief characteristics of the problem and consequently observe the set phenomena (Table 2).

**Table1:** Use of HS in problem solving in initial and final tests

<table>
<tr><th rowspan="2"></th><th colspan="2">SE</th><th colspan="2">UFA</th><th colspan="2">IAE (geometrical problem)</th></tr>
<tr><th>initial</th><th>final</th><th>initial</th><th>final</th><th>initial</th><th>final</th></tr>
<tr><td>STUDENT 1</td><td>successful with no HS</td><td rowspan="5">successful with no HS</td><td rowspan="5">successful via equation with no HS</td><td rowspan="5">successful with HS</td><td rowspan="5">successful with HS</td><td rowspan="5">successful with HS</td></tr>
<tr><td>STUDENT 2</td><td>unsuccessful with SE</td></tr>
<tr><td>STUDENT 3</td><td>successful with no HS</td></tr>
<tr><td>STUDENT 4</td><td>successful with no HS</td></tr>
<tr><td>STUDENT 5</td><td>successful with no HS</td></tr>
</table>

**Table 2**: Use of IAE in relation to context of problem

| | use of IAE and pragmatic commentary | auxiliary element as insight into problem | auxiliary element as simplification of problem |
|---|---|---|---|
| geometrical problem | all declare having used IAE | AE used in all cases | simplification did not appear in three cases out of five |
| geometrical problem, can be reformulated into algebraic | all declare having used IAE, some with factual commentary | AE used in all cases | re-formulation into algebraic problem in all cases |
| algebraic problem | two students used IAE with factual commentary, two students used SE, one used no HS | Impossible to judge | two students using IAE re-formulated the problem |

*3.2.3 Authorship phase*

The last data file was gained through author's problems that were to be formulated and aimed at individual HS by the students. We observed the following four criteria (a) how efficiently can the problem be solved through a declared HS; (b) up to what level it is analogical to problems known to them; (c) up to what level it is artificial and finally (d) how challenging it is.

**Table 3:** Author's problems with regard to individual HS (H=high, M=middle, L=low)

| | SE | | | | UFA | | | | IAE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 |
| (a) efficiency | H | H | H | H | M | M | H | H | H | H | H | H |
| (b) analogy | H | L | L | M | L | L | H | H | H | H | H | M |
| (c) artificiality | L | H | H | M | H | H | H | H | L | L | L | L |
| (d) difficulty | H | L | H | L | L | L | M | M | L | L | L | L |

The students managed to formulate such a task which is efficiently solvable through a declared HS (10H/2M) in all cases. However, vast differences occur among strategies in relation to (b) analogy and (d) difficulty. SE was the only case where one student (S3) managed to formulate the problem of high difficulty and low analogy at the same time. In the case of UFA higher difficulty also means higher rate of analogy. In the case of IAE high analogy even appears within low difficulty problems. We may generally state that the problems were significantly artificial (6H/1M) with the exception of those formulated in purely mathematical context, which was the case of 4 out of 5 problems aimed at IAE. In addition, all IAE problems were geometrical.

## 3.3 Development of didactic competences in use of HS in teaching

In the last third of their e-course, four students took part in a 3-week teaching practice. Within the frame of the practice they performed 3 observation lessons and 8 lessons of their own teaching practice. Concurrently, we opened an LSM Moodle discussion forum inviting students to: observe real didactic situations where some of the HS could be used; describe such situations, explain or suggest their alternative; and share your experience with others and give your opinions.

After the entire e-learning course had ended, we realized a face-to-face group discussion with four students. The discussion was lead by a research team member and it was recorded in a Dictaphone. The interview outline was set through initiatory questions focused on the usefulness of HS from the solver´s and the teacher´s points of view, on the specifics of individual HS and understandably on particular relevant experience from their teaching practice.

The students´ written contributions to discussions and the interview footage have been analysed through searching and sorting features indicating qualified analysis of a didactic situation. We then followed phenomena of students expressing their opinions to the didactic merit of HS. We based the procedure on the anchored theory by (Strauss and Corbinová, 1999). In advance we predicted features that characterise the given HS from the didactic point of view and we followed the statements which would either confirm it or deny it. The occurrence of the phenomena and students´ illustration of their expression are shown in Table 4. All data has been observed with regard to individual HS, or with regard to general pedagogical conduct and the students are considered as a group.

The students reflect four phenomena within the discussion forum. With the three observed phenomena they offered negative reactions. The students did not even once mention a particular instance from their own teaching practice; they always referred to a course situation, or should need be a hypothetical situation. Students commented on the observed phenomena within the face-to-face discussion more positively.

**Table 4:** Occurrence of phenomena observed, describing reflection of didactic importance of HS in teaching in the discussion forum (DF) and in the face-to-face discussion (F-FD); (+ stands for confirmation, - contradictory statement, ± both confirming and contradictory statements occur, 0 stands for its absence)

| characteristics of observed phenomena | occurrence | | students´ statements |
|---|---|---|---|
| | DF | F-FD | |
| HS develops mathematical thinking | ± | + | “UFA is not a strategy to develop mathematical thinking, it is a way round mathematics.“ |
| HS enables gifted pupils to solve non-standard problems | 0 | + | “It is good for kids who participate in mathematics competitions; it may help them a lot.” |
| HS enable unsuccessful pupils to solve problems | + | + | “UFA is for those who don’t understand it.”<br>“The task with the divisibility is too difficult for the pupils and I don’t think they would solve it, SE would help them count with concrete numbers.” |
| UFA is propaedeutics of the equation (algebraic) calculus | - | ± | “UFA is good where there are many an operation or where there fractions or percentage etc. occur.”<br>“I’ve got no idea what it could be good for.”<br>“In some cases it appears too useless to me and it complicates the solution.”<br>“I don’t want pupils to do it this way, but I want them to solve an equation.” |
| IAE used in regular teaching | - | ± | “With IAE, I cannot see how they would understand it.”<br>“I’m not sure if completing a drawing is already IAE, I guess there must be more to it.”<br>“All those employing goniometric problems were solved through an auxiliary element.” |

| characteristics of observed phenomena | occurrence | | students´ statements |
|---|---|---|---|
| | DF | F-FD | |
| student describing the use of HS during their teaching practice | 0 | - | "We were using no strategy, with what I taught, I can´t imagine." |

## 4. Discussion and conclusions

The realized study has enabled us to answer RQ1: We achieved to see that students managed to acquire all three HS so that they used them to solve the given tasks. They were even able to formulate (or find) tasks demonstrating effective use of the given HS. The above mentioned proves that it is possible to acquire selected HS through e-learning. It needs to be stated that some aspects of HS were not developed within the process of e-learning. In the case or face-to-face teaching we may expect the teacher to draw attention to them in a complex discussion about a partial solution or about HS in itself; whereas with the e-learning form, such aspects are to be aimed at with adequate activities while designing the e-course. Let us analyse individual HS in more detail:

The students mastered SE out of all three examined HS best. They were able to formulate relatively large-scale tasks, with more difficulty then and at the same time with less analogy to those provided. This strategy was the easiest to comprehend and use in classes even in their subjective evaluations. It corresponds with the results of a vast research carried out by Eisenmann et al (2015) with pupils of 12–18, where SE is shifted among the HS chosen spontaneously by the pupils without previous instructions given. We have also noted two occurrences at which it will be needed to concentrate our attention within further realization of the course. Firstly, some students used SE with a proof-based problem, which may have introduced an insight into the task but was not self-sufficient for the solution. Further, the completion was of concern (as well as the necessity to exploit all options) of the experiment, which were by large not reasoned by the attendees. The future courses (including the ISTT courses) will have to be enriched by tasks with two and more possible solutions so that a natural discussion about the reasoning to the completion could arise, or a follow-up of the experimenting.

The UFA strategy was considered easily understandable as well as problematic as long as its practical usage is concerned. In parts of acquiring solving skills and in parts of formulation one's own tasks showed no obstacles even though slightly weaker results were reached in comparison to SE, as illustrated in the commentary to Table 3. It is true that students did not discover the propaedeutic potential of this strategy. It was considered artificial, and it was even noted that "UFA is not a strategy to develop mathematical thinking". In such situation the discussion forum confirmed it as quite activating. In the case of face-to-face teaching propaedeutics of UFA is often mentioned by the lecturer and is exposed adequately as well as it is discussed, therefore such a phenomenon does not occur.

Acquiring the IAE strategy was without question the most troublesome in comparison to other HS and that even though this strategy as the only one was used adequately within the initial test. The students had trouble with its use in algebraic context mainly. It was acknowledged through author's problems where everyone formulated rather undemanding geometric problems. In the future course it will be needed to focus our attention on providing the students with more problems in various contexts (not only within geometry or algebra, but also for example combinatorics). Teachers those have participated in research of Eisenmann et al (2015) report that a relatively large number of problems need to be solved with the pupils (aged 12–18) with this strategy. In light of the development of didactic competences was the HS considered demanding and students only unwillingly accepted its chance to be employed into regular teaching.

Let us now consider a potential development of didactic competences for answering RQ2. Any course not taking part within a close attachment to teaching allows only limited and indirect options of influencing didactic competences. The lecturer in face-to-face teaching uses guided discussion, which is monitored by suitable illustrations. In case of e-learning, the role of the lecturer within the act of discussion is shifted to the background. As we read in Burns (2011), it is possible to reduce this adverse situation through either blended learning or a suitably designed LMS course, where a large scale of tools on offer will be used. In the case of tools based on social learning it is necessary to have a base of participating attendees of sufficient scope (Conner, 2012). That is also why we had no high expectations.

However, the students did not mention a single concrete use of HS in their own teaching practice. Not only we may suppose that such situations did occur, but a member of the research team observed 3 lessons and noted such situations. Partially it is also caused by low teaching experience of the students and we could presume that practicing teachers reach better results. Nevertheless, a range of researches tackling the ability of skills to qualified analysis of teaching signalizes unreadiness of teachers to perform this activity with no respect to the length of their teaching experience (Vondrová et al, in print).

From this point of view, the support of development of didactic competences of students through the course appears insufficient. The future e-course will have to strengthen activities enabling the development of didactic competences. There would be work with standard school problems and their analysis with respect to HS. Further activities demand various solutions of the same problem. As among others we read in McNeil (2011), activities based on the analysis of video footage of adequate real teaching situations are to be a challenge.

It is important to motivate the students to activities all throughout the course to do e-learning teaching with success. That is why we observed the rate of engagement into individual activities in the course of time. It was of decreasing character, but rose subtly towards the end of the course. The weak point in teaching we carried out was the engagement of students in the discussion forums. Thomas (2002) notes that "online discussion forums inhibit truly conversational modes of learning" (p. 364), which may also stand for a reason why in our case the basic activity was rooted in the character of the lecture. Even though it was the teacher who took the initiative, two of the five students did not enter the discussion at all, just followed it. We may state that the use of tools working in the mode of social learning is problematic for students taking part in our e-learning course. The potential of discussion forums is still rather huge and even with a small-sized sample (n=12) the influence on development of critical thinking has been registered (Corich, Kinshuk and Jeffrey, 2011). Since none of the attendees had had experience with e-learning before, it is possible that a greater time scope would have enabled the students to find their way in the environment and dispose of inhibitions to join in with the discussion forums.

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# Augmented Reality-Based Learning Systems: Personalisation Framework

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**Abstract:** The aim of the paper is two-fold: first, to perform systematic literature review of Augmented Reality (AR) learning systems/environments and, second, to propose those systems' personalisation framework based on applying learners' profiles/models and intelligent technologies. First of all, systematic literature review on research topic was conducted in Thomson Reuters Web of Science database. The review revealed that strides are being made in education using AR, although much needs to be done. The possibilities of AR application in education seem to be endless and bring many advantages to students of all ages. Few are creating content that may be used for educational purposes, with most advances being made in the entertainment industry, but many understand and realise the future and importance of education applying AR. Many studies argue that new AR-based learning systems are more effective in comparison with traditional ones. Teachers and students like learning content and activities provided by AR technologies. On the other hand, although the concept of AR has already been proposed more than 20 years ago, most applications are still limited to simple visualisation of virtual objects onto spatially limited scenes, and the developed systems did not pass the barrier of demonstration prototypes. Many authors agree that personalisation of AR-based learning platforms should be further analysed. Therefore, original personalisation framework of AR-based learning systems is presented in the paper. According to the framework, personalisation of AR learning systems should be based on applying learners' models and intelligent technologies e.g. expert evaluation, ontologies, recommender systems, software agents etc. This pedagogically sound personalisation framework is aimed to improve learning quality and effectiveness.

**Keywords:** learning personalisation, augmented reality, learners models, intelligent technologies, systematic review

## 1. Introduction

Research on AR learning systems/environments becomes more and more demanded in scientific literature. Possibilities of AR application in education are very wide and bring many advantages to students of all ages, although much needs to be done.

However, only several studies directly address personalisation question of AR-based systems in education. Many authors agree that the problem of personalisation of AR-based learning platforms is relevant and should be further analysed.

Therefore, original personalisation framework of AR-based learning systems, based on applying learners' profiles/models and intelligent technologies, is formulated and presented in the paper.

Personalisation of learning became very popular topic in scientific literature during last years (Spodniakova Pfefferova, 2015; Spruit and Adriana, 2015; Kurilovas, Zilinskiene and Dagiene, 2015; Wallden and Makinen, 2014). Application of learners' profiles/models based on different learning styles models (Kurilovas, Zilinskiene and Dagiene, 2015; Kurilovas and Juskeviciene, 2015; Juskeviciene et al, 2016) and intelligent (smart) technologies to personalise learning (Bobed et al, 2014; Kurilovas et al, 2014; Ermilov et al. 2014; Kurilovas and Juskeviciene, 2015; Juskeviciene et al, 2016; Kurilovas and Dagiene, 2016) are recognised to be effective in terms of improving learning quality and efficiency.

The reminder of the paper is organised into following interrelated sections. Systematic literature review on AR systems/environments applications in learning and its personalisation is presented in Section 2. Section 3 is aimed to discuss findings of the systematic review. Section 4 presents the framework for personalisation of AR learning systems using intelligent technologies. In Section 5, conclusions are made and future work directions defined.

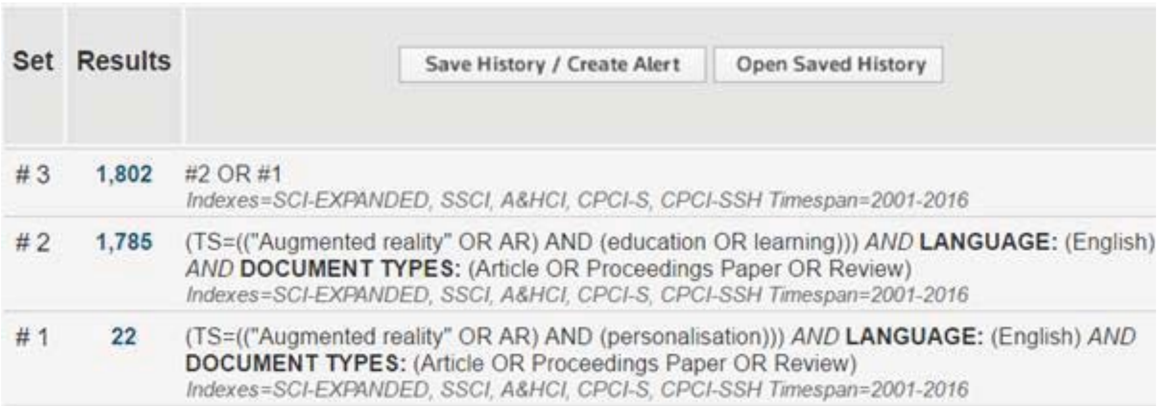
## 2. Systematic review

In order to identify existing scientific methods, applications and results on AR learning systems and their personalisation, systematic literature review method devised by Kitchenham (2004) has been used.

The following research questions have been raised to perform systematic review:

- What are the best practices of implementing AR in education?
- What are the ways to personalise AR learning systems according to learners' needs?

Systematic literature review was performed on March 20 – April 8, and continued on July 20 – August 10, 2016. The search was undertaken in Thomson Reuters Web of Science database. Search protocol in Thomson Reuters Web of Science is presented in Figure 1.



| Set | Results | Save History / Create Alert · Open Saved History |
|---|---|---|
| # 3 | 1,802 | #2 OR #1<br>*Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=2001-2016* |
| # 2 | 1,785 | (TS=(("Augmented reality" OR AR) AND (education OR learning))) *AND* **LANGUAGE:** (English) *AND* **DOCUMENT TYPES:** (Article OR Proceedings Paper OR Review)<br>*Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=2001-2016* |
| # 1 | 22 | (TS=(("Augmented reality" OR AR) AND (personalisation))) *AND* **LANGUAGE:** (English) *AND* **DOCUMENT TYPES:** (Article OR Proceedings Paper OR Review)<br>*Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH Timespan=2001-2016* |

**Figure 1**: Search history in Thomson Reuters Web of Science database

During the last 15 years (2001–2016), 1785 published papers were found in Thomson Reuters Web of Science database according to the topic *("Augmented reality" OR AR) AND (education OR learning)*, and only 22 papers were found according to the keywords *("Augmented reality" OR AR) AND (personalisation)*. We searched for articles, proceedings papers, and reviews. The results were combined using OR tool and that gave us a set of 1802 general results from Thomson Reuters Web of Science.

The process of selection of resources included the following procedures: analysis of all the results and excluding resources non-related to the topic of interest (e.g. specific medicine studies, papers that used "AR" abbreviation with different meaning). From the reminder of the results we selected most cited papers during the period 2001–2016. The most cited 2001-2013 publication set was enriched with the newest relevant publications in the field published during 2014–2016. The period of 2014–2016 was selected due to the meta-analysis studies we found while analysing the papers published before 2013. However, the format of this paper restricts us from presenting an extensive and detailed review of numerous results.

Therefore, on the last stage of Kitchenham (2004) systematic review methodology, 15 suitable resources were selected. The analysis results are as follows.

Many researchers state that although the concept of AR has already been proposed more than two decades ago, most AR applications in education are still limited to simple visualisation of virtual objects onto spatially limited scenes, and most developed systems are in the stage of demonstration prototypes.

Azuma et al (2001) provide one of the early overviews of AR technologies, published by the first author in 1997 and updated in 2001. The authors define an AR system as a system, supplementing the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world. AR system has the following properties: a) combines real and virtual objects in a real environment; b) runs interactively and in real time; c) registers (aligns) real and virtual objects with each other. The authors describe the technologies of AR interfaces, display, data visualisation and social acceptance. Some technological issues have been solved today, but researchers still mention limitations for educational use. For instance, Petersen and Stricker (2015) highlight two main drawbacks of existing AR systems for education: 1) educational content creation is too complicated and requires expert knowledge, and 2) the existing systems have little intelligence in terms of awareness about the current state of the scene and the user's context.

Diegmann et al (2015) state as well that although AR is one of the most emerging technologies in education nowadays, the value of AR in learning environments remains unclear. The authors have performed a meta-analysis of more than 500 publications (25 selected for an in-depth study) on benefits of augmented reality in educational environments. Researchers used a classification of AR applications in educational environments into five main directions: 1) discovery-based learning; 2) object modelling; 3) AR books; 3) skills training; and 4) AR gaming. The study resulted into identification of 14 different benefits and clusterisation of them into six groups. The benefits of application of AR in educational environments, identified by the authors, include:

- State of the mind: increased learner motivation, increased attention, increased concentration, and satisfaction.
- Teaching concepts: increased student-centred learning, improved collaborative learning.
- Presentation: increased details of educational contents, increased information accessibility, increased interactivity.
- Learning type: improved learning curve (students learn faster and easier), increased student creativity.
- Content understanding: improved development of special abilities, improved memory.
- Reduced costs.

However, the authors state that more in-depth research is needed, and "each AR application is in its own way unique and therefore the identified benefits may not apply in each context" (Diegmann et al, 2015).

A meta-analysis, conducted by Radu (2014), in addition to the benefits presented above, expose such benefits of AR in education: the learning content is represented in novel ways, in multiple representations over space and time, the user is physically enacting the educational concepts (including the abstract ones) and "record" tactile information, attention is directed to relevant content. This work has also pointed out some negative effects of AR application in education, including student's attention tunnelling, usability difficulties, ineffective classroom integration, and learner differences.

Bacca et al (2014) performed a systematic literature review on AR trends in education for the period of 2003–2013, and their findings of the analysis of 32 selected studies report that Science was the most frequent subject where AR was applied (40.6% of analysed studies). Most studies addressed Bachelor or equivalent target groups of students (34.38%). In the purpose of AR application dominated explanation of a topic (43.75% of studies), augmentation of information (40.63%), and educational games (18.75%). Two types of AR dominated in the analysed studies: marker-based AR (59.38%) and location-based AR (21.88%). Regarding personalisation, the authors state that only 2 out of 32 studies report some kind of personalised process and 1 out of 32 considered a user modelling process. However, further analysis of these resources has shown that it was not clear whether they had user model and whether the user model came from the user profile (Bacca et al, 2014, p 143).

Wu et al (2013) summarise previous research and analyse AR features and affordances for education according to 5 directions. AR could enable: 1) learning content in 3D perspectives, 2) ubiquitous, collaborative and situated learning, 3) learners' senses of presence, immediacy, and immersion, 4) visualizing the invisible, and 5) bridging formal and informal learning. However, these affordances may be not unique to AR systems, therefore authors add on instructional and learning approaches of AR and categorise them into emphasising the "roles", "locations", and "tasks". The authors also state the lack of flexibility of AR systems: "In some AR systems, the content and the teaching sequence are fixed; teachers are not able to make changes to accommodate students' needs or to accomplish instructional objectives".

Researchers confirm that AR applications help students to develop their spatial skills. One of earlier publications on 3D geometry learning using AR (Kaufmann and Schmalstieg, 2003) presents Construct3D tool, specially designed for mathematics and geometry education. The 3D model construction can be carried out in collaboration or individually. The hardware setup consisted of two wearable AR kits composed of back pack computer, stereoscopic see-through head-mounted display with camera, and custom pinch gloves for two-handed input. One kit could be worn by the teacher; the second one was available for use by students. A desktop system with FireWire camera was used for optical tracking, so that students could choose individual viewpoints, and even manipulate local copies of the constructed object. Students mentioned the following possible application areas: interactive conic sections, vector analysis, enhancing spatial abilities, intersection problems, experiencing space (for very young students) and building 3D worlds from 2D views, elementary geometry, visualisation of constructions, geometry didactics – learning by doing and training of spatial abilities by viewing objects from different sides.

Diaz, Hincapie and Moreno (2015) describe a practice of using AR to increase learning engagement and understanding of topics where spatial skills are involved, too. The point of interest of the researchers was type of educational content (static or dynamic) and how the type of content can affect the student learning experience in AR applications. An experiment in which the student interacted with the application, using static and dynamic AR contents supplemented by audio and text, for learning topics related with an electronic fundamentals course was performed. The results have shown that AR application was effective for teaching concepts of the fundamentals of electronics course, and there was a difference in the learning level of students when they use dynamic and static contents. However, authors state that further investigation is needed to confirm these findings.

Self-regulated learning using AR was the aim of research by Huang et al (2016). The authors apply AR to solve the problem of learning domain unawareness. Self-regulated learning model in the library is discussed in detail, and developed learning system utilizes the concept of combining mobile AR, indoor navigation and data mining algorithms. The authors propose the system that uses innovative indoor positioning technology to fulfil the goal of navigation inside a library and solve the problems of spatial and learning domain unawareness. The system allows peers to create a cloud-based information sharing community using asynchronous communication. The website and the app interfaces of the system provide both educational functionalities and mobility for readers. Proposed AR navigation function integrates the information of reading paths, the real-space locations, real-time dynamic information, book introductions and readers' comments to help readers have access to the topic-related books efficiently. The users of presented innovative people-centred library information system are guided to do systematic self-regulated learning, self-monitor their learning progress and to use the sharing mechanism.

Calderon and Arbesu (2015) in their article present an engineering lab in AR and mobile devices that combined with physical elements commonly found in an engineer lab, allows the development of experiments that reinforce or complements the theory, as well as the practical skills. The presented technology (Augmented Reality Automation, ARA), is built upon three main blocks: the virtual scenario, the socket system and the physical control system. ARA was incorporated in one of the Logic Automatism Lab course practices (activity of controlling a conveyor moving recipients that had to be filled with liquid at a certain point) and student opinion evaluation has showed increasing students' motivation and satisfaction.

Squire and Klopfer (2007) studied how handheld AR technologies can be used to enrich students' inquiry and provide new paradigm in environmental engineering education. The authors used situated learning as a pedagogical paradigm, which is not new, but AR brings new opportunities to it. AR simulations can combine positive features of simulations and probeware (known before) to nearly approximate the case of being able to explore the benefits of explorations in context, linking science and students' surroundings, with the nearly limitless inquiry potential of simulations by trying a more broadly applicable intellectual experience to a core disciplinary dilemma and scientific practice and using computational media to help students appropriate their real surroundings or authentic simulated investigations. The authors had previous experience of using pocket PC multimedia and simulation for storytelling. In this study they argue that AR simulations and role-playing gaming could entice students into complex scientific practices through adopting the personae of scientists. The AR simulation "Environmental Detectives" was used in three university classes and one high school class with total number of 58 participants. The teachers saw this game a useful tool for learning, the observations and interviews of students showed positive effect and high engagement. The authors suggest that there should be a partnership between the game developer and player, and a promising opportunity would be having students and teachers to become game developers.

An application of AR environment for elementary school students' inquiry-based learning has been reported in a study by Chiang, Yang and Hwang (2015). The authors concentrate on the promotion of knowledge sharing during inquiry learning activities and present a location-based AR environment with a five-step guiding mechanism aimed to guide students to share knowledge. The effectiveness of the proposed approach in terms of promoting the knowledge sharing behaviours of students was evaluated during the experiment, conducted in elementary school natural science course. The results of AR-based inquiry learning activity were compared to conventional inquiry-based mobile learning activity, and were in favour of AR-based inquiry learning activities. The findings of the study provide guidance for teachers to help them to develop effective strategies for AR inquiry-based learning activities.

Dunleavy, Dede and Mitchell (2009) analyse collaborative learning using AR systems and present "Alien Contact!" – a narrative-driven, inquiry-based AR simulation to teach math, language arts, and scientific literacy skills to middle and high school students, using a handheld computer and GPS technology. The students are involved into role-playing collaboration by applying jigsaw approach. The research was aimed at understanding how teachers and students made sense of and used AR while participating in "Alien Contact!". The researchers triangulated the data through the use of multiple types of data (observations, interviews, documents), multiple sources (teachers, students), and multiple researchers. The most motivating factors for students and teachers were: using the handhelds and GPS to learn, collecting data outside, and applying jigsaw approach. Students, who had low motivation in traditional class, showed high engagement in AR activities.

He et al (2014) discusses AR technology usage to design and develop mobile-based English learning software for pre-school children. The main driver for the authors was a wish to raise children motivation to learn and solve teachers' non-standard pronunciation problem. The mobile learning system integrates into learning materials virtual pictures, the meaning and pronunciation of words. An experimental evaluation with 40 students has shown that the students learning with mobile-based AR software had greater learning achievement than control group ones.

Student creativity is currently attracting considerable attention. Wei et al (2015) introduce two teaching aids aimed to support creativity and use them in creative design course: "AR Creative-Classroom", which explains the domain relevant knowledge of creative design, and "AR Creative-Builder", which helps students to build actual AR scenes. The results of a pilot study show that the proposed teaching scheme significantly improves learning motivation, student creativity, and the teaching of creative design. However, many teachers have only limited knowledge of AR, and software developers are not familiar with general creative design education, which makes it difficult to incorporate AR in such courses. The authors consider that the lack of relevant teaching facilities and creative design equipment means that the environment in which the technology curriculum is applied still has a long way to go to meet the real requirement of curriculum.

## 3. Findings of the systematic review

The review revealed that possibilities of AR application in education seem to be endless and bring many advantages to students of all ages. Few are creating content that may be used for educational purposes, with most advances being made in the entertainment industry, but many understand and realise the future and importance of education applying AR. Many studies report that their analysed AR-based systems were more effective in comparison with traditional ones, especially for situated, inquiry-based, collaborative and self-regulated learning. AR system may bridge the gap between formal and informal education. Teachers and students like learning activities based on AR systems, almost all studies mention improved students' motivation and satisfaction. The results also confirm AR educational systems' positive effect in developing spatial skills and creativity.

On the other hand, although the concept of AR is not new, most applications are still limited, the existing systems have little intelligence in terms of awareness about the current state of the scene and the user's context, and many authors agree that the use of the AR systems for learning should be further evaluated (e.g. Stricker, 2015). Many studies of AR still focus on development, usability, and initial implementation of AR tools (e.g., Wu et al, 2013).

However, out of 15 studies analysed in this paper, only one meta-analysis work (Bacca et al, 2014) directly addresses personalisation question of AR-based systems in education (this was one of the systematic review research questions raised by the authors). There were only two studies found, published in 2009 and 2013, addressing some aspects of AR system personalisation. Other studies found under the keyword, containing "personalisation", publish research results with aspects of personalisation from travel industry, manufacturing (e.g. footwear personalisation), etc., and do not relate to personalised learning using AR.

As reported in another meta-analysis work on the topic (Radu, 2014), some studies on learner differences have shown that low and average achiever students showed learning gains through the AR experience, while high achieving students did not receive the same benefits. In fact, the high achieving students showed more learning gains in a traditional classroom where AR was not used.

Another aspect of AR environments negative effects is that students may be cognitively overloaded by the large amount of information they encounter, the multiple technological devices they are required to use, and the complex tasks they have to complete (Wu et al, 2013; Dunleavy, Dede and Mitchell, 2009). These are the possible areas for further research on AR learning systems and their personalisation.

The majority of studies evaluate AR learning systems using experiment with a small or medium research samples (e.g. one class of students).

Finally, no studies have proposed technologically and pedagogically sound frameworks to personalise AR learning systems, models, prototypes or the whole AR based learning packages/scenarios/units. Such framework is presented in the following Section.

## 4. Framework for personalisation of AR Learning Systems using intelligent technologies

According to (Kurilovas, Zilinskiene and Dagiene, 2015; Kurilovas and Juskeviciene, 2015; Juskeviciene et al, 2016), learning software and all learning process should be personalised according to the main characteristics/needs of the learners. Learners have different needs and characteristics i.e. prior knowledge, intellectual level, interests, goals, cognitive traits (working memory capacity, inductive reasoning ability, and associative learning skills), learning behavioural type (according to his/her self-regulation level), and, finally, learning styles.

According to Kurilovas (2015), future education means personalisation plus intelligence. Learning personalisation means creating and implementing personalised learning packages (scenarios, units) suitable for particular learners according to their personal needs. Educational intelligence means application of intelligent (smart) technologies and methods enabling personalised learning to improve learning quality and efficiency.

In personalised learning, first of all, integrated learner profile (model) should be implemented. Dedicated psychological questionnaires should be applied here. After that, one should integrate the rest features in the learner profile (Kurilovas 2015).

The authors' approach to creating students' profiles is as follows:

- Selecting pedagogically and psychologically sound taxonomies (models) of learning styles.
- Creating integrated learning style model which integrates characteristics from several models. Dedicated psychological questionnaires are applied here.
- Creating open learning style model.
- Using implicit (dynamic) learning style modelling method.
- Integrating the rest features in the student profile (cognitive traits, knowledge, interests, goals).

After that, ontologies-based personalised recommender system should be created to suggest learning components (learning objects, activities, environments, tools, apps etc.) suitable to particular learners according to their profiles (Kurilovas, 2015).

Experienced experts should evaluate learning components in terms of their suitability to particular learners according to their learning styles.

Recommender system should form the preference lists of the learning components according to the expert evaluation results. Probabilistic suitability indexes should be identified for all learning components in terms of their suitability level to particular learners.

Thus, personalised learning packages/scenarios could be created for particular learners. A number of intelligent technologies should be applied to implement this approach, e.g. ontologies, recommender systems, intelligent agents, personal learning environments etc.

According to (Kurilovas et al, 2014; Kurilovas, Zilinskiene and Dagiene, 2015; Kurilovas and Dagiene, 2016), learning system/environment should include personalisation capabilities, e.g. should be flexible enough to be easily adaptable to different learners' needs. Therefore, personalisation criteria should be analysed while performing pilot evaluation of any VR/AR/MR learning environment or learning package implemented in this kind of system.

## 5. Conclusion and future work

The review revealed that possibilities of AR application in education are very wide and undoubtedly bring many advantages to students of all ages. Many studies argue that new AR-based learning systems are more effective in comparison with traditional ones.

Although the concept of AR has already been proposed more than 20 years ago, most applications are still limited, the existing systems have little intelligence in terms of awareness about the current state of the scene and the user's context, and many authors agree that the use of the AR systems for learning should be further evaluated.

Personalisation of AR environments and the whole learning packages should be based on learners' models/profiles using students' learning styles and intelligent technologies. AR learning system/environment should include personalisation capabilities, e.g. should be flexible enough to be easily adaptable to different learners' needs.

The authors' framework to personalise learning using AR systems/environments and intelligent technologies presented in the paper consists of the following stages:

- Creating learners' profiles/models according to their learning styles, cognitive traits and other needs.
- Creating interrelations and ontologies to establish suitability of learning components to particular learning needs.
- Creating recommender system to recommend suitable learning components to particular students.

Future work should include creation of ontologies, recommender systems and intelligent agents to propose students the most suitable learning components, AR systems/environments and full learning packages/scenarios according to their preferences to learning styles and other needs using research framework presented in this paper.

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# Using the e-Learning Acceptance Model (ELAM) to Identify Good Practice in the Provision of Online Tutorials

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**Abstract**: This paper seeks to evaluate the usefulness of the E-Learning Acceptance Model (ELAM) in relation to the module TU100 My Digital Life which is offered by the Open University in the United Kingdom. TU100 is only offered as a distance learning module therefore students have no choice in their mode of interaction. A combination of printed and online material is provided with students offered both face to face and online support at regular intervals throughout the module. The ELAM model will be used to evaluate the attitude of students and staff to the use of technology that supports the delivery of the online aspect of the module. Synchronous online activity is supported by a Tutor requiring the student to commit to regular participation in online activities. Neither Face to Face nor online Tutorial attendance is compulsory but some students are regular attenders at both activities. In order to determine the reasons for student participation the ELAM model will be used to evaluate the factors, if any, which influence their engagement in online activities and to what extent Tutor interaction influences their willingness to participate. One mechanism utilised for delivering online tutorials to the student cohort is a branded version of Blackboard Collaborate called OULive. This provides a stilted environment which depends primarily on a whiteboard based application and audio technology to support the online tutorial process. Applying and evaluating the ELAM model will allow the identification of good practice in the provision of online tutorials helping fellow practitioners cope with the demands of online delivery. The paper will conclude by demonstrating that while the OULive tool is dependent on whiteboard and audio technology students who engage on a regular basis do constitute a community of practice and demonstrate that participation in online tutorials as part of their learning experience is a worthwhile exercise. This therefore illustrates a certain level of acceptance of technology in their learning activities. This paper will demonstrate that a good level of support early on in the module to use online material is essential in helping this community of practice to form.

**Keywords**: e-learning, distance learning, synchronous communication, breakout rooms, problem solving activities

## 1. Introduction

Traditional learning is perceived to take place in a face to face environment generally with someone in charge of controlling the Learning Session. This paper attempts to examine how a Technology acceptance model can address the use of technology to replace face to face interaction and at what point students and teaching staff accept the technological learning as either being acceptable as an alternative to face to face interaction or as the norm for learning. Traditional University learning is built around Lectures, Labs and Tutorials. The key feature here is that someone is usually dictating the pace of the learning through the provision of specific material. The pace is controlled by the release of material through the Lecture and this material is put to use in some way in a Laboratory and in a Tutorial session. Online learning tends to remove the release of the material in a piecemeal manner and provides the learner with access to a combination of printed and online material. There is a perception with online learning that students studying in this manner still need some form of support from an academic. This support has come in many forms. Face to face support in terms of Lab Sessions/Tutorials and Seminars are one way of achieving this support. One to one telephone calls are another with conference calls between a Tutor and a number of students another medium that has been used. The major thrust now in supporting students at a distance is the use of collaborative tools which run over the internet. This leads us into a discussion of acceptance models of E-Learning and how the technology is embraced by academic staff and students. In particular how are these tools used as a means of supporting students in their study by providing synchronous communication opportunities to help students learn.

Our argument is as we embrace the electronic age and become more and more accepting of Information and Communication Technologies (ICT) in our workplaces, homes and in the mobile environment students will be keen to embrace this technology and engage with their academic leader in a synchronous manner.

Constructing the synchronous online Tutorial to support students can be a time consuming exercise and is not something that can be treated as a trivial exercise. Lambie & Law (2015) discussed how synchronous Tutorials should be organised in order to attempt to get a good level of interaction with a group of students in a synchronous online activity. Lambie & Law (2015) identified that there is a need to ensure that students have opportunities to speak and to put forward their answers in a supportive manner. The Woodcock et al. (2015) study of student Teachers supports the findings of Lambie & Law (2015) that there is a need for a good level of interaction to engage the learner. Woodcock et al. (2015) found that synchronous communication was thought of as being convenient but this was dependant on a "reliable internet connection" and also that "the "breakout rooms," "interactive whiteboards," "emoticons," and "hand icons" encouraged increased participation."

## 2. Technology and e-Learning acceptance models

Online Tutorials are increasingly seen as the way to deliver support for distance learning students. The use of a tool to support this activity is therefore central to any discussion on technology and e-learning acceptance models. Rosell-Aguilar (2006) concluded that Tutors and Students could get a positive learning experience through the use of conferencing type tools although the experience was not identical to the classroom experience. Blackboard collaborate is one of the most recent invocations of this type of tool. Perhaps then the challenge is not to reproduce the classroom environment as such but to look at what the online tool can provide and how this can be utilised to the best effect. Acceptance of the use of an online tool and the approach that it provides are therefore important.

The question that we were trying to answer is "Do students accept online synchronous Tutorials as useful?"

The E-Learning Acceptance Model (ELAM) as defined by Umrani-Khan & Iyer (2009) is based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model developed by Venkatesh et al. (2003). Umrani-Khan & Iyer (2009) model has the same "key determinants" as UTAUT but differs due to the use of e-learning specific variables within each key determinant. ELAM focuses on four factors: Performance expectancy, Effort expectancy, Social influence and Facilitating conditions.

The Umrani-Khan & Iyer (2009) model has the same "key determinants" as UTAUT but differs due to the use of e-learning specific variables within each key determinant. ELAM focuses on four factors: Performance expectancy, Effort expectancy, Social influence and Facilitating conditions. The model is presented in figure 1 below.

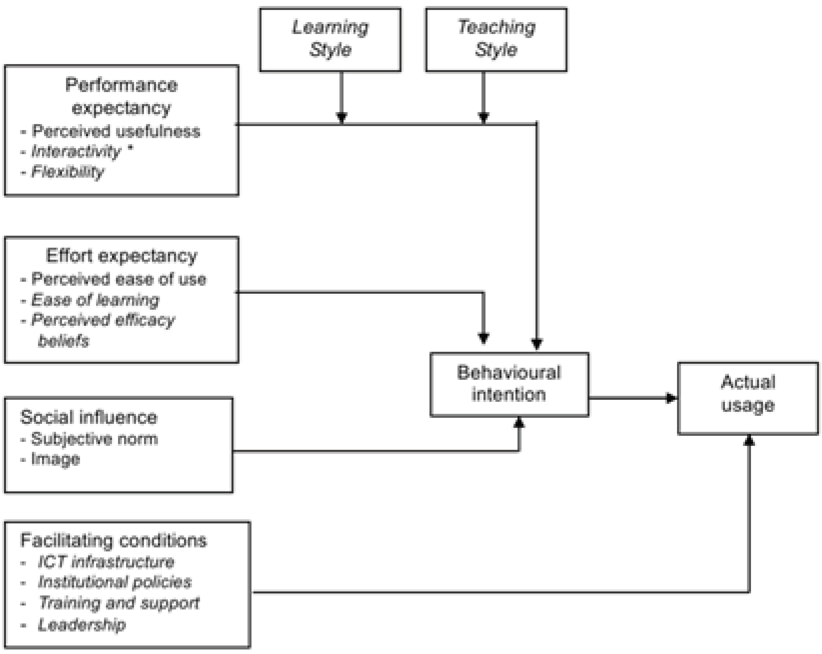


**Figure 1**: Umrani-Khan & Iyer (2009) e-learning acceptance model (ELAM)

Performance expectancy takes into account both the student and teacher viewpoint of a gain in the "teaching-learning process." The Effort expectancy takes into account both the student and teacher viewpoint of the level of effort required to use the e-learning tool. The Social influence takes into account both the student and teacher viewpoint of the social pressure to use e-learning. Facilitating conditions takes into account both the student and teacher viewpoint of encouragement on the institutions part to use e-learning. Online learning and learner support is a key part of the Open University's mission.

Factors such as age are important factors in the development of this e-learning/technology acceptance norm. Typical teenage (17+) students believe that it is acceptable to read a Tutorial sheet at a face to face Tutorial on their smart phones, tablet or laptop. In fact for then it is the norm. Many institutions now make extensive use of managed learning environments and one aspect of this is the provision of material electronically. In fact providing course materials in electronic formats is pretty much now the norm.

However there still seems to be a dilemma in that there is a level of acceptance of technology in some areas but a reluctance to participate in others. There seems to be a level of acceptance of accessing material and making contributions to discussions in an asynchronous manner but a lack of engagement in synchronous activities. Woodcock et al. (2015) indicate a number of issues with synchronous communication for the learner; the perception that it is "less convenient" and "more intimidating" in comparison to their perception of asynchronous communication as flexible and anonymous. Woodcock et al. (2015) also point to the juxtaposition of synchronous e-learners having the benefits of "more consistent communication, greater focus on tasks, increased participation, and more frequent completion of their work and courses" compared with e-learners who prefer asynchronous communication.

Experience has shown that face to face Tutorials tend to suffer from low turnout and that the attendance rate falls away as the course progresses. There is a level of expectation that students will buy into the "new" technologies and embrace them fully. Students on TU100 My Digital Life which is the course being used to investigate e-learning acceptance models (see section 3.1) sign up to an online correspondence course where support is available on line. They do not need to leave their homes to participate but at least 75% of them do not avail themselves of this offer. Asynchronous activities such as the use of email or leaving messages on forums seem to be a more popular means of communication. Students' time management is still an issue in their participation in synchronous online activities. Interestingly it has been pointed out by Brown & Charlier (2013) that e-learning doesn't always attain its full potential due to a high level of attrition and low usage rates suggesting that the availability of an e-learning tool is no guarantee of its use nor does it guarantee that it is an effective tool.

Students studying with the Open University tend to do so because the OU offers a more flexible approach to learning and they are less constrained as to how and when they study. The flexible learning model presented by Peters (2007) illustrates the nesting and overlapping with flexible learning of e-learning and m-learning. The Open University integrates e-learning and m-learning into its flexible study approach.

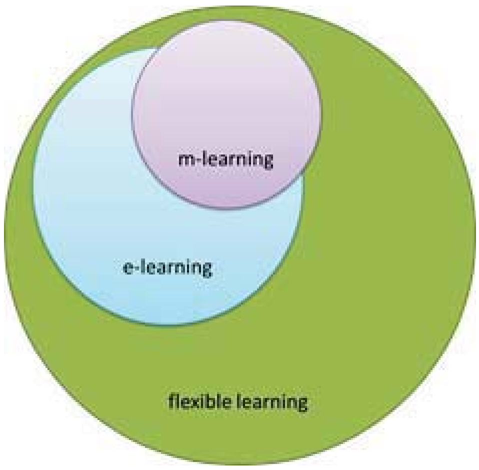


**Figure 2:** 'Just enough, just in time, just for me' model of flexible learning

Does m-learning generate competition between learning and students other commitments? "For example, one participant, who had three children, attended the live-time tutorial via iPhone while watching his/her son's soccer match." (Woodcock et al. 2015) So, perhaps, Tutor expectations for the possibilities offered by e-learning are too high. Perhaps the flexibility of m-learning generates too much competition for learners' time.

Kuo et al. (2014) also stress the importance of interaction citing three forms: learner-instructor interaction, learner-learner interaction, and learner-content interaction suggesting the first two forms are important to online learners. The example cited by Woodcock et al. (2015) indicates the conflict in the learner-instructor and learner-learner interaction when the learner is not fully engaged due to a conflicting distraction.

## 3. The preliminary study

In order to investigate these observations a questionnaire was developed which aimed to focus on specific aspects of the delivery of the Open University (OU) course TU100 My Digital Life. Experience of delivering online Tutorials on this course indicated that the following points were worthy of investigation:

- Student attitude to their own personal use of technology
- Level of acceptance by students of the use of technology as a means of study on TU100
- Level of usefulness to the student of the online tutorial tool used to deliver synchronous tutorials as part of the support offered to students on TU100

These are aspects that are important to the Tutor on TU100 because they are likely to influence the level of student engagement with the online aspects of the course. The questionnaire was influenced by the work carried out by Umrani-Khan & Iyer (2009) and looked to investigate some of the findings in a specific context of a single course that was delivered and supported online.

Experience of Tutoring on the TU100 course over a number of years showed that there was a need to consider how to use synchronous Tutorials to good effect in order to engage students and to encourage them to attend further on line sessions (Lambie & Law 2015).

The idea was to use the results from the questionnaire to determine the level of acceptance of technology and to try and judge how students on TU100 were using technology and how their attitudes influenced their choice and style of study. The authors were particularly interested in student attitude to online Tutorials and the reasons students choose to either engage or not engage in this activity. Students sign up for TU100 as an online correspondence course but this does not necessarily mean any sort of level of acceptance of the use of Technology. It is the author's experience, that in any one year, 75% of students in a Tutorial Group of 20-24 either do not engage regularly or do not engage at all in organised online Tutorials.

Studies such as that carried out by Goodfellow (2014) indicate that students who engage in online Tutorials feel that it is a worthwhile exercise.

There is no real option on the tool that is used to carry out the online Tutorial. The tool that is provided by the Open University (OU) is Blackboard Collaborate badged as OULive. This tool provides a Whiteboard centric interface Woodcock et al. (2015), Rosell-Aguilar (2006). Audio is the main communication tool that is used particularly by the Tutor to guide students through the Tutorial activities. When this is combined with the white board with information in the form of instruction or data being displayed an interactive environment is produced in which a wide range of problems can be tackled. Preparation is the key (Lambie & Law 2015). The whiteboard cannot be created in an ad hoc manner as the Tutorial progresses. The theme and the exercises are best worked out in advance.

This limited study is looking to identify factors which will help practitioners particularly with the synchronous aspects of online delivery where Tutors are looking to engage with students online in a Tutorial type environment. The study was carried out within the author's own tutor groups and has provided some insight into student perceptions on the use of technology.

### 3.1 TU100 my digital life

The Open University in the United Kingdom is a distance learning institution with a world wide reputation for delivering online courses and making use of ICT technologies to deliver these courses. TU100 My Digital Life is an OU distance learning course. It is a level 1 university course aimed at students who intend to go on and study further courses in Maths, Computing and Technology. Material is provided as a series of course books and a course web site. The course web site has a calendar based approach and students use this site to receive direction on what they should be studying at any particular point in time. Assignments are accessed electronically and some course material is only provided electronically. The course web site also provides a link to allow students to submit their assignment electronically. Students are assessed by 5 Tutor marked assignments and an end of module assessment which is marked by a different Tutor.

Students support is provided by a Tutor who typically has around 20-24 students. Tutors provide face to face Tutorials and online Tutorials using Blackboard Collaborate (Badged as OULive). The use of OULive is a key piece of technology for helping to support students.

## 3.2 General questionnaire findings

The questionnaire findings are based on 15 respondents, although not a large number, this is sufficient to draw some initial conclusions. The questionnaire consisted of 24 questions broadly covering the four factors: Performance expectancy, Effort expectancy, Social influence and Facilitating conditions identified by Umrani-Khan & Iyer (2009).

### *3.2.1 Student attitude to their own personal use of technology*

Figures 3 & 4 indicate that there may be an interrelationship between students who believe technology enhances their day to day lives hence allowing them to undertake a university course. This is an interesting finding as this indicates that a liking of technology has facilitated their learning.

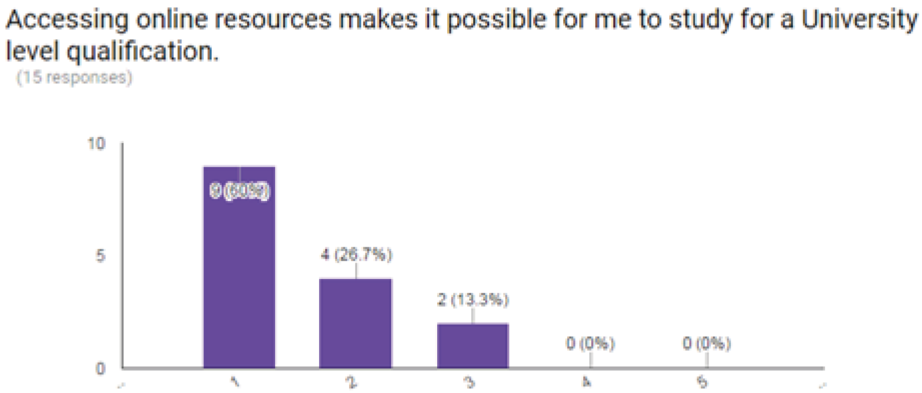


**Figure 3**: Accessing online resources

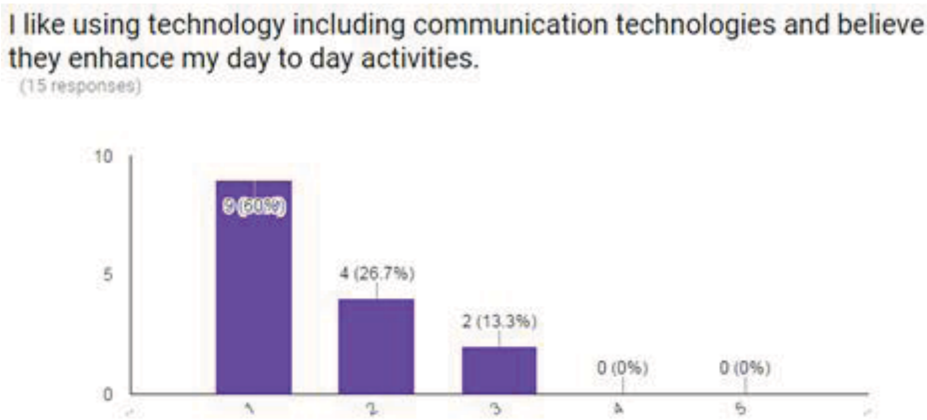


**Figure 4**: I like using technology

### *3.2.2 Level of acceptance by students of the use of technology as a means of study on TU100*

Figure 5 is interesting as the use of mobile technology is not as pervasive as expected given the respondents indicated they are happy using technology (shown in Figure 4).

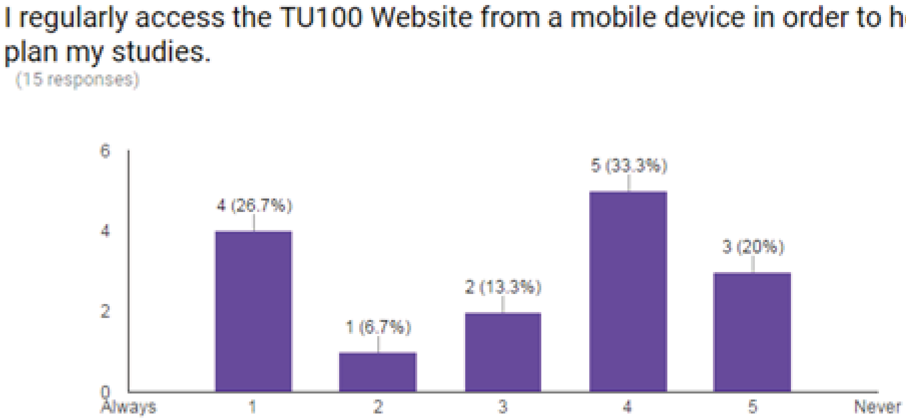


**Figure 5**: Access from a mobile device

Figure 6 indicates that 80% of respondents prefer, in principal, online tutorials to face to face tutorials due to the perceived convenience, however, this not borne out by experience as the recorded attendance is up to 25% of the registered student population.

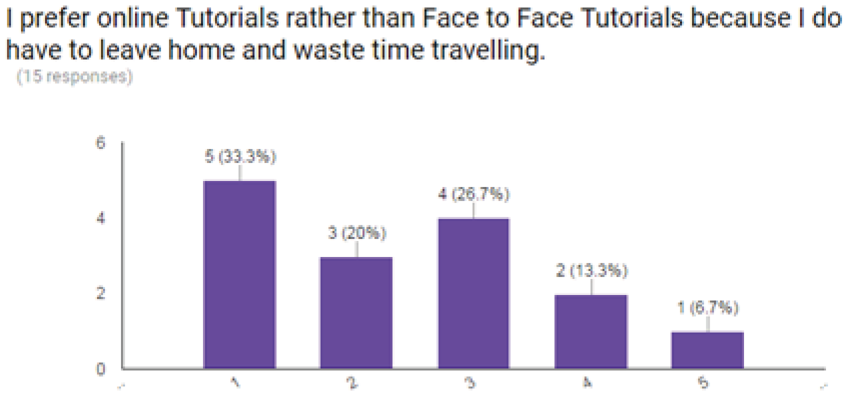


**Figure 6:** Preference for online tutorials

*3.2.3 Level of usefulness to the student of the online tutorial tool used to deliver synchronous tutorials as part of the support offered to students on TU100*

Figure 7 shows that only 10 of the 15 respondents have attended an online tutorial, however, the 10 that have attended appear to be broadly happy with the features available.

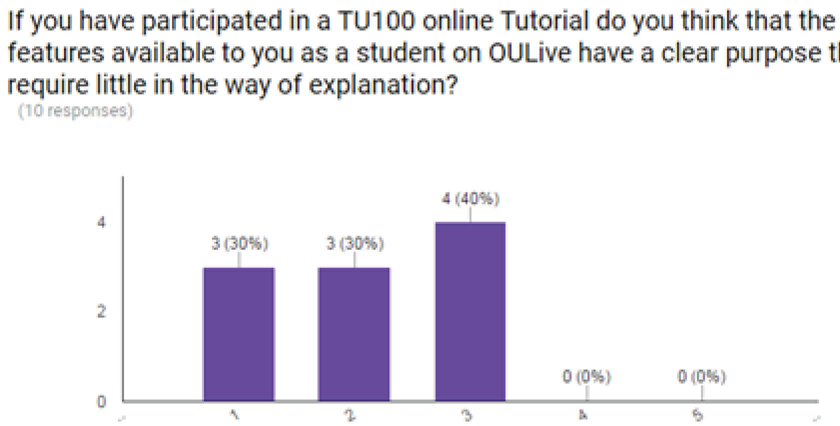


**Figure 7**: OU Live features

Features offered in OULive include breakout rooms, interactive whiteboards, emoticons and hand icons. Figure 8 shows that only 10 of the 15 respondents have attended an online tutorial, however, the 10 that have attended appear to be broadly happy with the use of the whiteboard.

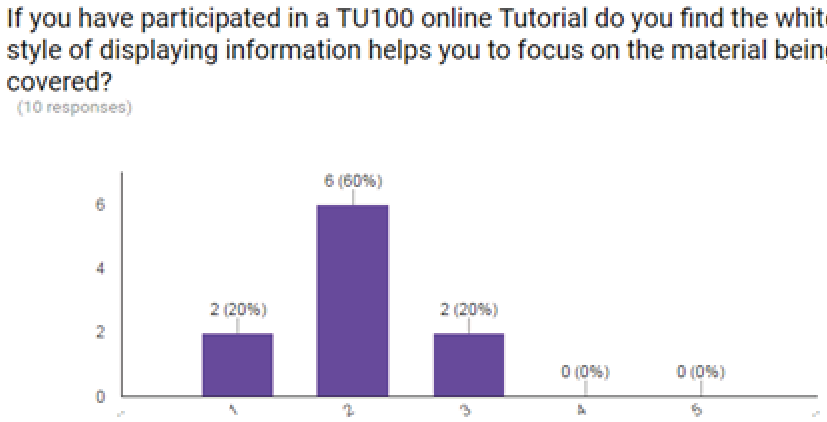


**Figure 8:** Whiteboard use

### *3.2.4 Summary of questionnaire findings*

Summarising the findings from the questionnaire it seems that students have appropriate access to ICT technologies to be able to participate in online activities but attendance at online Tutorials is mixed. Students' attitude to online tutorials and their reasons for attending are not clear cut and could be said to be mixed at best.

Students who were not good attenders indicated that they were not able to find the time to attend online Tutorials or that it was too difficult to organise their time to be able to attend online Tutorials. Students who were active attenders generally considered themselves to be active participants. There does appear to be some kudos in attending online tutorials.

One very interesting result from the questionnaire reveals most students who attended online tutorials indicated they preferred to type rather than to speak as a way of contributing to the online activities. This has been observed in practice by the authors and is an area that needs further investigation to determine and understand the underlying reasons for this.

Students seemed to like the problem solving based approach and the use of the whiteboard in the online Tutorials.

## 4. Conclusion

The questionnaire has confirmed issues that have been observed in practice but has also raised areas that need further investigation. Tarhini et al. (2013) suggests that to determine the successfulness of an e-learning system it must provide a classroom experience and acknowledge the students' needs, however, if the students do not use the system then the systems benefits will be under-utilised. This seems to have been borne out by the response to their preference for online tutorials, where 20% of respondents did not really agree and the fact that 33% of the respondents did not attend any online tutorials.

Using a synchronous communication tool, such as OULive, has a number of advantages including reduction of travelling time (evidenced by the fact that 80% of questionnaire respondents agreed), immediate clarification from the Lecturer to any questions from the learner and "simulated experience of a real classroom learning setting" (Kuo et al. 2014).

The concept of the online tutorial replicating the experience of a real classroom learning setting has been cited in a number of the papers reviewed (Brown & Charlier 2013; Kuo et al. 2014), however this may not necessarily be the approach required to engage today's technology savvy students whose approach to flexible learning, e-learning and m-learning may be such that they require to consider an alternative paradigm.

In terms of practical solutions that can be tried and given the reluctance on the part of students to talk in an online session one development that is being explored is to make more use of Breakout rooms as a means of encouraging communication between students on a peer to peer basis. Observational experience suggests that students are a lot more talkative when they are left in a separate breakout room on their own. Therefore there is scope for modifying the Tutorial activity to give students their own space to work in a collaborative manner. This would build on the questionnaire result that students were broadly happy with the problem solving type activities that have been used.

OULive provides the Tutor with the option to promote the privileges of a student to allow a different level of contribution. For example one of the students could be temporarily granted higher privileges to allow the sharing of an application in order to try out a solution as part of a programming example.

The more difficult question to answer is getting the students to attend the online sessions. From the questionnaire it can be determined that there are a small number of students who will not attend any sessions but there are a large proportion of students that will attend at least one session. It is therefore imperative that these students are encouraged to return to future sessions by making the tutorial content interactive, engaging and fun. This is by no means an easy task and from experience takes time to prepare and on occasions may necessitate an impromptu improvisation to keep the tutorial activities flowing.

In conclusion the results of the questionnaire, although not extensive, suggests that maximising the delivery of online tutorials for both student and lecturer is worthy of further exploration.

## 5. Future work

The questionnaire that was developed was used within the author's own Tutor groups. This has given some insight into the attitude of TU100 students to the use of technology and to their level of acceptance of their use of technology. A more substantial survey based on the questionnaire used is planned on a national level. This will give the authors the opportunity to investigate the use of technology and level of acceptance on a national scale for a particular OU course. The authors will be looking for any regional variations in the attitude and use of technology.

Determining the hardware used by students for connecting to OULive sessions could shed light on how they interact during these sessions as it is conceivable that they may be using kit that does not afford them the full range of interaction provided by OULive. The student perception questionnaire will be revamped to include new questions on student perception of the use of breakout rooms, the type of hardware used during the OULive sessions and the type of internet connection being used. A second questionnaire will be developed to capture the views of the tutors delivering the sessions.

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# How to Design Affect-Aware Educational Systems: The AFFINT Process Approach

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**Abstract:** Computer systems, that support learning processes, can adapt to the needs and states of a learner. The adaptation might directly address the knowledge deficits and most tutoring systems apply an adaptable learning path of that kind. Apart from a preliminary knowledge state, there are more factors, that influence education effectiveness and among those there are fluctuating emotional states. The tutoring systems may recognize or predict affective states of a learner and react to them to foster success of an educational process. This paper explores, how techniques derived from affective computing and user-centric design might be applied in intelligent tutoring systems development. An affective intervention is a modification of a standard control path or system behaviour that is a response to user's affective state and aims at providing effective execution of a task (learning). There are several criteria for a good intervention model for an application. A system should make an affective intervention only when required and refrain from intervention otherwise. Interventions should be a natural element of an interaction with application and should be tailored to a user state. The ten step process, called AFFINT, was proposed to design appropriate affective interventions. In this paper the process is adapted to the domain of technology-based learning. The steps of the process are analyzed, providing insight into designing educational systems that react to the recognized or predicted emotional state of a learner. The study is based both on literature review as well as it is supported with a design case study of an educational tool. The paper shows, that combining affective computing and educational systems is possible and beneficial. The paper might be interesting both for researchers, working on educational processes and supportive tools as well as for developers, aiming at designing effective tutoring systems.

**Keywords:** affective learning, emotion recognition, affective tutoring systems

## 1. Introduction

There is a number of factors that influence the success of an educational process. Intellectual ability, preliminary knowledge and environmental support of a learner are among those. Emotional intelligence is also mentioned among the most significant ones (Goleman, 1997). The latter factor is even more important, when dealing with e-learning processes and especially self-learning tools and resources. In a classroom, a teacher creates environment to learn, eliminating distracters, motivating and maintaining attention of a learner. The more we proceed to on-line environments, the less control a teacher has. As a result, the success in technology-supported educational processes is more dependent on learner's ability to focus, deal with fluctuation of concentration and motivation, resistance to distracters. Perhaps educational tools are unable to control distraction conditions at a learner's desk. But there are new emerging domains, such as affective computing that might be able to provide techniques addressing fluctuation of a learner's emotional state.

Affective learning has already got some focus in recent years (Robinson, McQuiggan and Lester, 2010; Huk and Ludwigs, 2009; Picard et al, 2004). We know much on effective and counter-productive emotional states. For example both fear and boredom have destructive influence on educational outcomes, while slightly negative and active states (moderate frustration) foster critical thinking and are appropriate for learning (Landowska, 2013a). In a classroom a good teacher naturally influences the learners' emotional states by direct statements (praise or reprehension), small gestures (nodding and other bodily expressions) and intentional distractions (eg. telling a joke to de-stress). Is it possible for an educational software tool to do the same thing – to evoke an optimal emotional state of a learner and keep him/her in?

Affective computing is a domain that focuses on taking into account emotions in human-computer interaction. In recent years the domain proposed a significant number of tools, algorithms and even off-the-shelf solutions to recognize human affect and to influence it. As the number grows, choosing the ones, that would be suitable and appropriate in a certain condition becomes challenging.

This paper aims at addressing the issue of adapting affective computing methods to learning processes and especially to designing affect-aware educational tools. *Affect–awareness* of an educational system is defined as "*the system being aware of an emotional state of a learner and being able to make an intervention, when a learning process is endangered*" (Landowska, 2013a).

In this paper we propose to adapt ten-step Affective Intervention Design Process (AFFINT) to designing affect-aware educational systems. The AFFINT approach was proposed to design affective interventions of systems applied in any domain (Landowska and Szwoch, 2016). In this paper the general AFFINT process is adapted to specific requirements of educational systems. The thesis of this paper could be formulated as follows: "*The Affective Intervention Design Process (AFFINT) supports design of affective interventions in educational systems*".

This paper provides a step-by-step analysis of the AFFINT process followed by a case study of an educational system design. The paper is organized as follows: section 2 outlines the most important research findings that influenced the described study; section 3 provides adaptation of the AFFINT process to the specificity of educational domain; section 4 contains a case study description; section 5 provides a summary of results and discussion followed by concluding remarks in section 6.

## 2. Related work

The works that mostly relate to this research fall into two categories: (I) studies on affective phenomena in educational processes and educational tools; (II) research on efficiency and design of affective interventions performed by computer systems.

(I) Combination of affective learning and affective computing is frequently explored in reasearch, as affective computing researchers often apply their methods in learning process analysis. Moreover, lots of methodological and didactic findings are achieved by the means of technology-enhanced learning monitoring (Landowska, 2014). For example the states of frustration and flow as well as emotional states in different types of educational tasks were explored (Noteborn et al., 2012; Ahn & Picard, 2006). However, the research usually focuses on one perspective or one emotional state only, for example only on frustration or only on boredom (Bessiere et al, 2006; Scheirer et al, 2002; Ang et al, 2002). Woolf et al (2009) proposed a set of useful cognitive-affective terms scales for emotion labelling dedicated to learning processes. The states were additionally assigned numeric representation of desirability in educational processes (for example concentration was rated 2- 'highly desirable', while boredom was rated 0 – 'not desirable').

There are some examples of a successful application of affective computing methods and tools in analyzing impact of affect in technology-enhanced education (Baylor, 2011; Moreno & Mayer, 2007; Rovai, Wighting, Baker & Grooms, 2009). There are also some examples of affect-aware tutoring systems that address the issue of students' emotional states recognition and elicitation (Sarrafzadeh et al, 2008; Van Mulken, André & Müller, 1998). Another study of dynamics of affective states in complex learning processes emphasis, that a learner frequently and smoothly oscillates between the equilibrium of flow and other states (Calvo & D'Mello, 2010).

(II) There is little literature on the efficiency and design of affective interventions. However, there are studies confirming, that affective intervention (positive and negative voice messages) influences problem solving performance (Partala&Surakka, 2004). Beale and Chris (2009) report the influence of affective agents on a user, including a phenomena of 'emotion's contagion'. There are two studies that significantly contributed to the research described in this paper: Hook's (2005) report on evaluation of affective interfaces and Lottridge's at all (2011) who provided a study on understanding, evaluating and designing affective interaction. The first study emphasis, that no 'normal user' existence should be assumed for affective interaction, and that adaptive approach is the most efficient. The study outlines, that special concern should be assured for issues of affective intervention timing, control of interaction and effects of antropomorphism. The second study provides a set of guidelines for putting emotion research findings into practice, including: affective interaction as a criterion in user testing, enhancing user performance through emotional input and regulation, visualizing emotions for decision support, and fostering appropriate emotions for different goals.

Basing on the literature review presented above and according to the author's best knowledge, there is no method proposed for designing affective interventions of educational systems.

## 3. Adaptation of AFFINT approach to educational tools

Let us consider an example of an educational system that supports the effective learning process. Some emotions, e.g. boredom or fear, are known to disturb learning and the system may recognize and address these undesirable emotional states in order to keep a user on the desired educational path.

Three important questions might be asked: (1) How to detect emotions in an educational system? (2) How an educational tool might perform affective interventions? (3) How to determine, when to perform an intervention?

The main factors determining affective intervention design include: effective emotional activations specific for the system context of use, available emotion elicitation channels, possible system adaptation mechanics and available emotion recognition solutions.

The coordination of automatic emotion perception (recognition or prediction) and affective interventions is a part of the balance for effective support by affect-aware systems. The determinants of affective intervention design are provided in Figure 1.

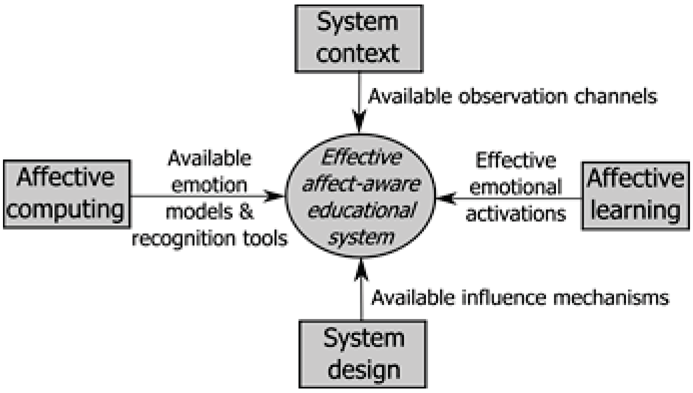


**Figure 1**: Determinants of affective intervention design

Designing affective intervention might be decomposed into a step-by-step process using the AFFINT approach. In the following subsections each step of the generic process is adapted to fit to educational systems design.

<u>AFFINT Activity 1. Application goals and tasks</u>
The design of an affective intervention requires identifying the main goals of the application first, as the intervention purpose is to support the process that a human performs within the system. Educational systems should address rather effectiveness in the process of gaining competence than entertainment of a user. In this step, one should simply name an educational system goal, i.e. what competence components are to be enhanced by the system, including knowledge, skills and attitudes.

<u>AFFINT Activity 2. Effective emotional activations</u>

This activity defines, which emotional states are effective and counter-productive for the application goals. In educational systems one might refer to extensive bibliography on affective learning, some references are already provided in the related work section.

A number of general guidelines of the affect influence on learning processes can be derived from literature (Landowska, 2013b):

- emotional states of very high or very low arousal (both positive and negative valence) disturb learning processes - boredom is an emotional state, that should be avoided in learning processes,
- emotional states with high arousal (both positive and negative) foster remembrance of facts,
- educational processes are supported by the states of engagement, concentration and flow,
- different emotional states support different learning tasks,
- slightly negative states are better than positive ones, as the negative states foster critical and analytical thinking,
- emotional states with higher dominance factor support learning processes (moderate anger is better than fear in educational environment).

The general guidelines might be a starting point in determining more specific effective emotional activations of an educational system.

AFFINT Activity 3. Available input channels

Recognition of an emotional state of an application user can be based on diverse characteristics, including: facial expressions, body posture, textual inputs, behavioural patterns, physiological parameters, voice modulation and so on. However, in most cases only a small subset of them is available in the system context of use and some of the available channels might be too noisy to reliably recognize user emotional states.

The third activity of the process aims at naming, which of the input channels used in emotion recognition are available and to estimate the level of the noise attached to them in daily use of application.

In educational systems, that are designed for distance learning, we can usually rely only on: textual input, behavioural patterns of application usage, video and sound channels. Availability of the channels can be also user-dependent or time-dependent. Thus, it is important to distinguish, which input channels will be available for all, and which for some of the users as well as to identify possible timing limitations.

It is worth noting, that the input channels should be also permitted to use, not only available in the system context.

AFFINT Activity 4. Available emotion elicitation techniques

Emotional state of a learner could be:

- explicitly reported by a user,
- predicted on the basis of OCC model,
- recognized basing on available input channels.

A mixed approach might be considered, starting with a self-reported or predicted state and confirming it with observation and emotion recognition algorithms.

If video input channel is available, one might consider recognition of user emotional state from facial expressions analysis, which is one of the most popular and well explored solutions.

Sound channel analysis is one of the promising approaches to emotion recognition, as often our voice modulation reflects the emotional state more than the words we say.

Behavioural patterns of mouse and keyboard usage, as well as the user's interaction with a system, can be used for emotion recognition, however accuracy of emotion recognition based on these characteristics only is limited and can be improved by using a multimodal approach, e.g. fusing recognition results from multiple channels. For textual inputs sentiment analysis would also be an option, however, the written words might be relevant information on affective state only in some applications.

AFFINT Activity 5. Emotion recognition granularity and methods

This activity decides on emotion recognition granularity and methods as a synthesis of the activity 2 (that defines, what is required) and activity 4 (that outlines, what is technically available in the system context).

The effective emotional activations should be expressed in the chosen emotion recognition representation model. There are some available solutions (libraries) for emotion recognition from text, facial expressions or sound, that provide results in a certain emotion representation model only.

For example, if an application reacts to stress only and the chosen input channel is facial expression, there is a need to map the outputs of the emotion recognition process to stress. Most facial expression-based solutions provide an estimate of six basic emotions: joy, anger, fear, surprise, disgust, sadness, and only some of those correspond to stress (anger, fear, perhaps also disgust). It is worth noting, that some mappings require lots of knowledge on affective phenomena and might be inaccurate. As a starting point in the educational solutions one might consider estimation of flow state based on oscillation between the frustration and boredom, as provided in Figure 2.

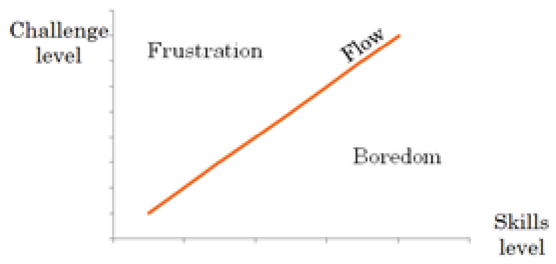


**Figure 2**: Flow as a state between frustration and boredom

AFFINT Activity 6. Available output channels and interface metaphor

Interface metaphor is a concept of interaction with an application. A role of the metaphor in user interface is to facilitate orientation, understanding and learning in the application improving its intuitiveness and usability. Discrepancy between the metaphor used and what occurs in an application is called mismatch and may decrease user satisfaction with the system. Affective interventions should follow the interface metaphor in the application and should use similar output channels.

A family of educational systems might contain software tools, that are significantly different in terms of interface metaphor they use, eg. an educational game, a learning platform with courses (learning content management system, LCMS) or an adaptive tutoring system. The aim of this activity is to name this metaphor, as it is a pre-requisite to define possible affective interventions, that might naturally blend into it.

AFFINT Activity 7. Possible affective interventions of an application

The goal of this activity is to list all possible system reactions to any change of user's affective state. Reactions (interventions) might be as subtle as a change of music tones or flashing an icon, but also as spectacular as a full screen animation, a reaction of an avatar or a message from the off-voice. As designer's imagination can be boundless, the considerations on the interface metaphor should limit it.

For an educational game, this activity should list game logic and mechanics that might be adjusted during execution time. For an adaptive tutoring system one might define, in what terms a learning path is adjusted, but also how an interface might change. For learning platforms, possible changes are limited and one should perhaps utilize more subtle adjustments. In some educational systems for children, an off-voice or a virtual character is introduced and the constructs might be naturally used for the interventions.

AFFINT Activity 8. Affective intervention triggering rules

The next activity aims at pairing emotional states that a designed system should react to, with affective interventions that the system would perform. When defining affective interventions triggering rules, one should consider gradation of an emotional state (perhaps different reactions should be performed for high and low arousal of the emotion). Some randomization of affective interventions might be considered for a more realistic impression.

AFFINT Activity 9. Affective intervention constraint rules

The ninth activity in the AFFINT process was added to consider limitations of triggering affective interventions for the purpose of providing natural impression of interaction. The system should not perform interventions that are annoying or seem unnatural considering the interface metaphor used in the system design. For every affective intervention scenario three constraints should be considered: compatibility with the interface metaphor, conformance with the current state of user-system interaction and possible repeatability interference with the natural user experience.

AFFINT Activity 10. Validation with end users

The last activity was added to loop back and perform some evaluation of the design. Validation of the ready software or a prototype with real end-users should be considered as an optimal evaluation method, but also some other evaluation methods might be applied. The observations derived from this activity might be then applied in re-considering the decisions made in the previous activities.

## 4. Case study of an educational game

A case study of a Pixel Empire educational game is described in order to exemplify the AFFINT process activities in practical settings. The study is presented using activities 1 to 9. The game is under development and performing the 10$^{th}$ step is planned when a prototype is executable.

**Pixel Empire** is a serious game developed at Gdansk University of Technology and it aims at education on enterprise finance management. Gameplay starts with a simple one-location production company. Both development constant and variable costs must be managed and the player manipulates the volume of production to get an optimal profit. The game becomes gradually more and more complicated, as more sites might be added, magazines, transportation, sales are to be managed. During the gameplay randomized positive and negative events are introduced, that require players reaction (eg. a new customer or a strike). One looses a game, when the company cash flow is negative (bankruptcy). A screenshot of Pixel Empire is provided in Figure 3.


**Figure 3.** Pixel Empire game screens design – main view

AFFINT Activity 1. Application goals and tasks

Pixel Empire is an educational game that aims at introduction to basic terms in finance management. Goals regarding knowledge include: understanding of variable, constant and mixed costs, understanding of income and profit terms and insight into the effect of scale. Goals regarding skills include: managing volume of production, activities forming demand and costs, management of risks and opportunities. Goals regarding attitudes include forming an active mind-set towards risks and providing positive experience of being a company manager.

AFFINT Activity 2. Effective emotional activations

A general model of oscillation between boredom and frustration is assumed. Boredom is a state that might result in abandoning the game and missing some issues that are introduced at more advanced levels. Slight frustration is considered productive in this learning context, however strong frustration is undesired. The optimal state is flow, assumed as a correspondence of growing skills with challenges encountered in the game.

AFFINT Activity 3. Available input channels

Available input channels include: video channel (user-dependent availability), mouse movements dynamics, behavioural observations of interaction with the game. Text and audio interaction channels are not used.

AFFINT Activity 4. Available emotion elicitation techniques

Available emotion elicitation techniques include: self-report, prediction based on a state of a game and recognition based on the available input channels (video, mouse movements, game interaction observations).

AFFINT Activity 5. Emotion recognition granularity and methods

Self-report on emotional states was disqualified, as it would not blend naturally into the system context and metaphor. The first iteration of the game uses a prediction model only, and OCC model is applied.

Estimation of a temporal emotional state of a learner is expressed with a single continuous value from <-1,1> range, where 1 indicates boredom, -1 denotes frustration and a user's states should oscillate around zero.

Emotion recognition is planned to be applied in the second version of the game as a confirmation of the predicted emotional state. Video channel (whenever available) and mouse dynamics will be used as emotion recognition techniques.

AFFINT Activity 6. Available output channels and interface metaphor

Pixel Empire has a form of a typical platform game and has multiple game mechanisms that might be used to perform affective interventions. Also some distracters are available and acceptable in the game. There is neither leading character, nor off-voice agent.

AFFINT Activity 7. Possible affective interventions of an application

Possible interventions include manipulation of the randomized events that are equivalents of business risks and opportunities):

- changing frequency of opportunity or risk events,
- changing opportunity/risk events ratio,
- changing probabilities of materialisation of risks/opportunities or size of loss/profit associated with the events.

Another acceptable support is providing tips, when a player seems too overwhelmed (frustrated) with the stream of events.

AFFINT Activity 8. Affective intervention triggering rules

If a learner oscillates within (-0,2; 0,2) range of emotional score, the game difficulty follows a standard progress path. If a learner is slightly frustrated , i.e. (-0,5; -0,2), the level of difficulty is not increased. If a learner is more frustrated, at first some tips are displayed. If the frustration is not reduced, the level of difficulty is reduced or an immediate positive event is introduced.

Boredom at range (0,2; 0,5) is addressed by accelerated increase of difficulty. A more intensive boredom level is addressed by immediate launch of a negative or positive event and general increase of event frequency.

AFFINT Activity 9 . Affective intervention constraint rules

The interventions based on events are constrained with no-repetition rule (two consecutive events are always different). Tips are not repeated within the same session of the game.

The AFFINT process was used to design the affective intervention model of Pixel Empire game. The 10th activity (evaluation with real users) will be performed when a clickable prototype of the game is ready. The decisions on the affective intervention model might be then revised.

## 5. Summary of results and discussion

The case study was presented to exemplify how each of the activities of the AFFINT process might be applied in educational systems design. The study shows, that the AFFINT process might be used at the stage of educational system design. The process is not dependent on chosen emotion representation model, nor recognition solution. Moreover, an observation might be made, that the emotional intervention design is an iterative process. The process is planned to be repeated with consecutive versions of the applications.

Based on the presented study, some practical Implications for educational systems designers might be formulated:

- Iterate. The 10$^{th}$ activity results might determine, whether another iteration is required.
- Start with a simple model of effective emotional activations. It's better to address some emotional states than none. Sometimes it might be advisable to intervene too little than too much.
- Start with unambiguously unproductive states like anger (strong frustration), fear and boredom.
- If none of the emotion recognition algorithms is available to you, you might start with self-reported or predicted emotional states.
- List the system tasks and mechanisms – provide a description or at least some idea of: difficulty (what might frustrate), stress (fear), repeatability and waiting (boredom). Adapt the difficulty of tasks to the reported/predicted/recognized emotional state of a learner.
- Start with simple interventions, as distracters, focus-gaining interruptions and simple adaptations of difficulty might help to achieve system's goal – education effectiveness.
- Even if the educational system is not a game, you might consider gamification of boring activities (or introduction of focus-gaining interruptions).
- Some situations in educational environments might evoke fear, which is known as the most destructive for learning. Make a pause from fear – introduce de-stress interruptions.
- Ask learner, how he/she feels. Sometimes just asking for an emotional state evaluation is an optimal affective intervention.

Based on this analysis, the thesis "*The Affective Intervention Design Process (AFFINT) supports design of affective interventions in educational systems*" might be accepted. However the author is aware of the fact, that the presented study is not free of limitations. The main limitations of the study include: arbitrarily chosen application for case study and using one case study only. The choice of a case study was based on the availability criteria. The selected application is implemented at Gdansk University of Technology in the frames of undertaken research projects. Despite the limitations, the presented study might be interesting both for researchers, working on educational processes and tools in e-learning and developers, aiming at designing effective tutoring systems.

## 6. Conclusion

Designing affective interventions of educational systems is a complex process of finding a compromise between the available solutions, effective mechanisms and also the effort put to developing them. If the educational goals are not endangered, and the learner is self-motivated and determined to follow the learning path – there is no need for the emotional intervention. But in many educational contexts and levels, the affective component is essential in achieving educational goals. Perhaps children education is one of those contexts, where maintaining learner's attention and concentration remains a challenge. If a human teacher, tutor or mentor is available – he might address the issues of fluctuating emotional states, sometimes by his presence only. However in some environments, technology-based, off-line or massive courses, a system might support a learner not only in cognitive, bur also emotional aspect.

Human emotions influence every aspect of life – decision making, relationship building, effectiveness of performed tasks. The educational systems might ignore the fact (actually most of them do), but development of new technologies and solutions allows to imagine, that the software solutions might adapt more to fully support humans.

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# The Flipped Virtual Classroom: A Room for Involvement and Engagement?

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**Abstract**: Students learn best when they are active and engaged. Providing courses via online medium has made this difficult. Although synchronous sometimes, it is still difficult to muster engagement. Several ways of triggering engagement has been used; plenary work with cases and assignments, reflective processes and more. It is only a handful of students that respond. This paper presents a different approach to increase engagement; introducing the Flipped Virtual Classroom. Flipping the classroom has proved to me most effective in face to face education. By making students responsible for their own learning process by encouraging them to contribute towards the lecture and using their own background and experiences, it is possible to increase the involvement and engagement. The paper presents, based on theory on involvement and engagement, and e-learning, different ways of organizing the Flipped Virtual Classroom. Looking at the single factors that make up the Flipped Classroom and adapting this to the online medium, is something that will be tested on a class at Hedmark University of Applied Sciences.

**Keywords**: flipped classroom, involvement, engagement, e-learning, learning outcome, transactional distance

## 1. Introduction

To engage and activate online students is sometimes quite difficult to achieve. In ordinary classroom education, one way of activating students have been to “flip” the classroom; meaning that one deviate from the “ordinary” lectures where the lecturer holds a monologue only interrupted by questions and answers. This “deviation” can be done in different ways; one way is to provide students with video lectures and then use the time in class to do exercises, solve assignments and discuss different issues related to the curriculum. There is a simple definition of “flipped” or “inverted” classroom: “Inverting the classroom means that events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa” (Lage, Platt et al., 2000).

Bishop and Verleger states: ”We define the flipped classroom as an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom” (2013).

In the table below, Bishop and Verleger show two definitions of the flipped classroom. The first (table 1) show a restricted definition, and the second (table 2) show a broader definition.

Table 1: Restricted definition of the flipped classroom.

| Style | Inside Class | Outside Class |
|---|---|---|
| Traditional | Lectures | Practice Exercises & Problem Solving |
| Flipped | Practice Exercises & Problem Solving | Video Lectures |

Table 2: Broader definition of the de-facto flipped classroom.

| Inside Class | Outside Class |
|---|---|
| Questions & Answers | Video Lectures |
| Group-Based/Open-Ended Problem Solving | Closed-Ended Quizzes & Practice Exercises |

**Figure 1:** Two definitions of the Flipped Classroom (Bishop&Verleger,2013)

At Hedmark University of Applied Sciences, Campus Rena, online education has been offered for several years. Some study programs are only as online education, some are online and seminar based study programs.

Flipped Classroom has also been used at Hedmark University of Applied Science. Offering video conferences prior to the lectures, and then use the time in the seminars on solving assignments and discussing the curriculum from a practical perspective (Vold, 2014b).

In MOOCS (Massive Open Online Courses) that are courses that are free of charge and most teaching material is free to download and share, the dropout rate is close to 90% (Featherman, 2014). Knowing this and at the same time have a pressure of making as many of the students pass in order to receive payment from the government. The budget model show that the Universities get at sum of money for each student, most of it *after* graduation, motivates the Universities to adapt practices in such a way that they provide studies with less dropout rates.

In this paper we explore, based on a theoretical approach, the possibilities of using elements from the Flipped Classroom in a virtual version; hence the Flipped Virtual Classroom. The paper presents research on existing approaches. The paper will also present how this can be implemented and how it is possible to measure the effect of the implementation.

## 2. Research on online teaching

In this part of the article we will present finding from Lervik's ongoing work with her PhD thesis which is focusing on keys to success in online teaching. Among these key factors are *the size of the groups* involved and the use of compulsory *on-campus seminars,* and we will now elaborate on the importance of these factors.

A teacher faces several pedagogical challenges when doing online teaching and among the most important are communication, dialogue, engagement and interaction between teacher – student. These challenges are reinforced by the fact that the teacher communicates through technology in a digital context. Several Colleges has chosen to have large groups when teaching online and in some classes, one teacher will teach up to 150 students. Our assumption is that to large groups of students in teaching online will limit engagement, activity and contact. As a part of the research for Lervik's PhD thesis she has interviewed 13 teachers teaching online at Telemark College and Northern University, Nesna department. The research has included mapping of local practices and discussions regarding the individual teachers' subjective experiences from teaching online.

The data show that lectures from both colleges perceive teaching online as more demanding that traditional teaching. Common for both colleges are that they do not use recorded lectures, but that the teaching is conducted in real-time as this is believed to provide a better teacher-student relationship including a better environment for questioning and discussions. Despite this, the teachers find communication with students through web based technology more difficult than communicating in a classroom. One loses eye contact, presence, the students expressions and not to mention the value of good conversation. Moore (1997) called these universes that exist between teacher and learner relationship when separated by space and/or by time for the *transactional distance*. The transaction that we call "online teaching" occurs between teachers and learners in a context having the special characteristic of separation of teachers from learners. It is this psychological and communication space that is the *transactional distance.* According to Moore (1997) videoconference media will permit a more intensive, more personal and more dynamic dialogue than can be achieved in using a recorded medium. Programs that use audioconference systems are therefore likely to bridge the transactional distance more effectively than programs using recorded media.

The Colleges studied here take advantages of several different conference systems in their lecturing online. One of the Colleges uses a conference system where the students can ask questions to the teachers and fellow students whilst being in class. Most of the teachers' agree that the chat function make it easier to get in touch with the students. The chat function gives the students the opportunity to ask questions, challenge the lecture and fellow student with questions whilst being active during class.

To achieve high activity, engagement, the good conversation and presence with students, both Colleges arrange physical compulsory *on-campus seminars* before and during the semester. The gatherings have no more than 50 students and last from four days to a week. They cover topics like technology, writing courses, library procedures, administrative information, collaborating working groups, individual conversations, and social activities. The purpose of arranging these physical gatherings is to get better acquainted and to promote good relations between the students. To make engagement and activity in lecturing online it is crucial that students are comfortable and well acquainted with each other. Most of the teachers claim that both size of the group and physical compulsory gathering is a critical factor to make the activity and presence during lectures online.

### 2.1 On-campus seminars

Both colleges organize two or more compulsory physical *on-campus seminars*, one before and one during the semester. All of the teachers claim that it is very necessary to arrange physical gathering before the semester starts. *On-campus seminars* may vary from four days and up to a week. As the students come from all over Norway it is important that the gatherings are attractive in regards to student output. *On-campus seminars* include activities such as introduction to technology, writing courses, getting to know the library, administrative information, group establishment, group work, individual conversations, and behavioral knowledge in real time use, lecturing, social dinners and other social activities. The purpose with these arrangements is to become better acquainted and to promote good relations between the students. These are considered key factors to success as this will make it easier for the students to be active and engaged during lectures and seminars. Some of the teachers state that many of the students would like more physical *on-campus seminars.*

### 2.2 Group size

The number of students in the individual online lecture is also a considered a critical factor (Bates, 2005)assumes that the size of classes involved in online education and the number of overall students involved are key factors in order to succeed with communication, dialog, activity and group discussion. According to Moore (1997) are number of students one environmental factors that will influence dialogue, activity and the transactional distance between teacher and learner. Large student groups being lectured online may inhibit the lectures interactivity with the students, which might cause more one way lectures without possibility of discussions, confrontations and critical questions. Foley (2003)presume that group size or number of students online is a critical factor regarding the importance of communication, interaction and discussions. Palloff and Pratt (2003)(p.118), claims that an experience teacher might handle between 20-25 students online whilst an unexperienced might handle only 15. Research shows that both quantity and quality interaction with the lecturer is a critical factor for success in online lecture (Woods, 2002). In accordance to Palloff and Pratt (2003), they recommend having no more than 10 students whilst lecturing online because of the plausible confusions and inhibit communication with so many students simultaneously.

Both colleges have chosen relative small groups of students for their online lectures and the individual groups vary between 10 and 50. The teachers that have up to fifty students online claim that it is too many to handle and that with this many students the presence of the conversation and activity disappear and the lecturing become mechanical and monologues. Many of the teachers would like fewer students in their online lectures as they believe that this would result in a higher quality.

## 3. Sociocultural learning

Sociocultural learning focuses on dialogue and interaction. In the cases above video recordings of the lectures are combined with seminars where the lecturers and students communicate via a video conferencing system.

The sociocultural learning perspective rests on three basic preconditions (Manger, Lillejord et al., 2013):

- A person learn when he/she take part in a knowledge process
- A person is an active creator of knowledge
- Knowledge can change

In the sociocultural perspective, learning is a part of the different areas of praxis we take part in. Researchers in this field look at the individual, social and cultural relationships and how these relationships contribute towards learning and development in each person. The person learns when it works with knowledge in a social context. It is thus important for a lecturer to prepare for learning activities involving dialogue, communication and interaction in order to increase the students' engagement. This may include presentations, group work that engage and involve students actively regarding creating knowledge. The knowledge developed is regarded as construed through interaction that is related to a context. The student is regarded as active and learning is developed in cooperation with the student and the surroundings in certain contexts (Moore, 1997)(p. 182). «The context contributes towards deciding what is to be learned and how something is learned»(Moore, 1997)(p.182). This means that the context is significant in the learning process. In education the learner not only learns the content and the curriculum, but also about the context of the learning. We learn to cooperate, work in group and the lecturers work methods. The lecturer's adaption and structure of the education and the learning environment affects the learners learning outcome and learning experience. Cooperation and interaction between learner and environment through social relations will be an important process regarding developing learning.

According to sociocultural learning theory knowledge is mediated. This mediation is found in the different relations the student is a part of and that form the context. The individual and the context is mutually connected through the interaction with the environment. The dialogue is, according to sociocultural learning theory the most important mediating tool for the persons' communication, action and thinking (Dysthe, 2002).

Understanding and development develop gradually through dialogue and cooperation with others where the involved parties contribute towards meaning and understanding (Lave and Wenger, 1991). It is important for the lecturer to make the student engage in dialogue in order to contribute towards discussions in order to obtain an active relation to knowledge. Learning is a praxis we take part in, or is tied to the different actions we execute (Manger, Lillejord et al., 2013).

According to the sociocultural learning theory it is not enough to activate the student, but the content and the lecturer (facilitator) is central to the process. The learner (facilitator) must present the curriculum, activate and follow up with support and supervising. The theory promotes a pedagogical practice that offers the student's feedback regarding their work. It is expected that the lecturer's praxis prepares for productive learning processes that include learning activities where the students work together and learn from each other under guidance and support from the lecturer.

According to Manger, Lillejord, Nordahl and Helland (2013) it is important that the lecturers didactical knowledge has to be embracing which pedagogical actions to use in order for the students do be able to contribute towards active participation in social communities of learning.

The sociocultural learning perspective emphasizes both individual and social learning activity as a cooperation. According to Dysthe (2002) language and communication can be bridge between the individual and social learning activities. Our language contributes towards developing our knowledge. By taking part in work with others and by valuing others opinions in an educational setting can contribute towards us learning and developing our understanding.

From a sociocultural perspective it is the learner's activity, support and supervising from peers with more experience that is central to the development of collective knowledge. Thinking and learning is based in the social setting and in the interaction, and the bridge between the individual and the social is the communication. Learning is co-created with others, and it is through interaction one construe knowledge. Learning in a sociocultural perspective emphasizes adaption by communicative and technical tool. These tools are according to Bråten (2002) mediating tools in a social praxis, and it is important to facilitate mediated learning in an educational setting, meaning education consisting of a dialogue between teacher and student.

## 4. Transactional distance

According to Moore (1997) perceived distance that can arise between the lecture and student is called "transactional distance". *«It is the psychological and communications space that is the transactional distance»* according to Moore (1997) (p. 22). Transactional distance emphasizes dialogue as a success factor in different types of distance education. According to Moore (1997) it is not so much about the geographical distance between teacher/lecturer and student, but that the theory is a pedagogical concept. The concept describes the relationship that emerges when a lecturer and student is separated in time and space. The transactional distance can be the distance that is related to understanding that may lead to a gap in the communication that can lead to misunderstandings. Large transactional distance can lead to reduced motivation, isolation and lack of engagement, according to Moore(1997) (p. 22).

Moore (1997) further suggests that there are three variables that can influence the transactional distance. These variables need to work cooperatively if one wants to reduce the distance between the lecturer and the student, and to obtain meaningful learning situations. The three variables Moore refers to are: **dialogue, the structure of the study program, and the autonomy of the students.** According to Moore (1997) (p.24) the dialogue is developed in the interaction between lecturer and student. He states: *«A dialogue is purposeful, constructive and valued by each party»(Moore, 1997).*

Choice of media will influence the dialogue as this will have an impact on whether it increases or reduces the dialogue between the lecturer and the student. An increase of dialogue will reduce the transactional distance. It is important that a lecturer combine both asynchronously and synchronously communication in order to minimize the transactional distance. Asynchronous like video lectures communication is not enough to minimize the transactional distance. Video streams are a form of communication, but following up with videoconferencing can be beneficial as it reduces the transactional distance. The dialogue can become personal and individual where the lecturer and student may correspond with each other.

Another issue that may influence the dialogue and transactional distance is the number of students. If the number of students is high, this will have an impact on the frequency of opportunity for communications. Too many students may hinder dialogue as it may be too many to share a limited time with.

T*he dialogue also determined by: «.. the content or subject-matter which is studied, by the educational philosophy of the educator and learner, and by the environmental factors"(Moore, 1997)(p. 25).*

The structure of the study program is about the flexibility or rigidity built in to the lecturing methods and strategies that are used in the study programs. Courses and study programs are structured differently. A video lecture is for example rather structured. The student has no possibilities of inflicting the content of the video lecture. However, a lecture conducted as a video conference may have more room for dialogue and thus have less structure. According to Moore(1997) there are many lecturers that use video conferencing and thus structure the content which contributes towards constraining the dialogue and increase the transaction distance. Other cases with more dialogue and less structure contribute towards a lower transactional distance.

The third variable that Moore (1997) promotes is the students autonomy, or self-efficacy. The learners autonomy is, according to Moore: «… *the extent to which in the teaching/learning relationship it is the learner rather than the teacher who determines the goals, the learning experiences, and the evaluation decisions of the learning program*» (Moore, 1997). Data show (Moore, 1997) that many students make use of the learning material and the study program alone to achieve goals, independently of a lecturer. However, there are differences between adults that havernot studied in a while, and the younger students with less experience. Moore (1997) states: «While only a minority of adults might be practicing as fully autonomous learners, the obligation on teachers is to assist them to aquire these skills». Students with advanced competency as autonome students are comfortable with less dialogue and little structure, and equally; students with less advanced competency need more dialogue and structure.

According to Moore (1997) videoconferencing as media contain several possibilities for good interaction and dialogue, as well as one can adapt for more individual dialogue and less structured study program.

Another form of dialogue has arisen within this medium; «inter learner dialogue» (Moore, 1997), where the students in real time can communicate with the lecturer either alone or together with peers.

Groups can collaborate with other groups and one can share experiences and knowledge. These factors help to reinforce students' motivation and independence. It is important that the lecturers support the students self-efficacy rather than being too dominant in the lecturing, something that will increase the transactional distance.

Use of video conferencing in net-based study programs can help and engage students in engaging in meaningful discussions with lecturers and peers.

## 5. The Flipped Virtual Classroom

Given the idea of reducing the transactional distance, flipping the classroom and making the classroom virtual, we will present some suggestions that we will test out in the course of "Learning organizations" in the fall of 2016.

The course is net and seminar based, with three one day seminars distributed throughout per semester. The seminars are structured after the traditional flipped classroom model (see figure 1, table 1).

The net based version is planned as follows:

- Video streams
- Video conferences approximately one week after the seminar
- Offer supervising via video conference (on assignments)
- Offer student driven Q&A (Questions and Answers) in the LMS (Learning Management System)

### 5.1 Video streams

Video streams are a part of the "ordinary" flipped classroom. Even if video streams according to Moore (1997) increases the transactional distance, they are a part of what defines the flipped classroom. And since students report on extensive use and high satisfaction (Vold, 2014a) regarding video streams, we will keep this element.

### 5.2 Video conferences

Video conferences will be offered to all students, also the ones that take part in the face-to-face seminars. This will provide the net based students with an alternative that helps reduce the transactional distance and thus be a better offer to these students.

It will also be a better offer to the students that attend the seminars. In fact, according to Ergan, Vold and Nilsen, the physical meeting clearly support work in distributed media (Ergan, Vold et al., 2014), as research on Virtual Communities of Practice shows. This is also why the video conferencing will take place *after* the (physical) seminar. In this way, the video conferencing will thus be an amplified added benefit to the students that also attend the (physical) seminars.

### 5.3 Supervising via video conference

There are some constraints that apply when supervising or advising via video conference systems. For instance, the nonverbal communication that takes place in the physical meeting will be lost (Pettersen and Løkke 2004, Skagen, 2011). Also establishing the advisor-student relationship that involves trust issues, may also suffer in the digital meeting.

However, having the opportunity of video conferencing makes the meet between the student and advisor is somewhat better than the asynchronous choice of email. By video conferencing we have reduced the transactional distance that concerns Moore (1997) .

### 5.4 Student driven Q&A in the LMS

The LMS in use is called Fronter, and offers a possibility of co-writing in a web-based document. To have the students add questions and have fellow students answer and elaborate, will support the cooperative approach of making students respond to each other. The document will be monitored by the lecturers and any misguiding answer or unclear responses will be addressed. This approach to student centered and student driven approach to sharing knowledge will support the reducing of the transactional distance.

By offering these adaptions and reduce transactional distance, we hope to reduce the drop-out rate and increase the involvement and engagement with the students. By this involvement and engagement and closer relation also with the net-based students, we hope also to enhance the learning outcome (Filstad and Blåka, 2007).

## 6. Method

It is important to investigate how the implementation will be received and if this reduction of the transactional distance will lead to an increased learning outcome. A qualitative method of inquiry will be used, and a survey using Questback(a tool for distributing surveys) and interviews will be undertaken(Creswell, 2003, Dalen, 2011, Denzin and Lincoln, 2005, Patton, 2002). Also, the lecturers will be encouraged to write reflective journals regarding their work with this approach (Bassot, 2013, Moon, 2006). These journals will along with their field notes, serve as observant material and thus make an important contribution towards the material that is to be analyzed. The interviews will be with groups of students (present at seminars) and with individuals. To validate the data and to make them reliable, member checks will be undertaken (Guba and Lincoln, 1989).

The analyzis wants to unveil the meanings, experiences and views of the students, this can be viewed as investigating a social phenomenon. It is thus important to collect in-depth explanatory data, and draw patterns and insights from these data. The approach will have resemblance to Action Research (Coghlan and Brannick, 2014, Furu, Lund et al., 2007, Greenwood and Levin, 2007). The students and lecturers (participants) will contribute towards the combined research material and the lecturers will do investigations on their own praxis. Also the undertaking can be viewed as a case study (Stake, 2000, Stake, 2005, Yin, 1981).

## 7. Conclusion

The flipped virtual classroom will in the next semester be introduced in the course “Learning Organizations” in the half-year study program “Knowledge Management”. As indicated above, in order to reduce the transactional distance and thus enhance the learning outcome of the net- and seminar based course.

The course has as a standard video streams and seminars. Also an LMS is used to provide a platform for sharing and collecting theoretical input like articles. Assignments are handed out and students’ answers are collected in the LMS.

The new adaption will be to offer video conferencing for all the students, both the ones that did not attend the seminars and the participants in the seminars. Also it will be to offer supervising/advising via video conferencing. Previously this has been done via email. The last adaption is to offer the students’ a Q&A (questions and answer)co-writing document in the LMS, providing a space for peer learning within the class, monitored and quality assured by the lecturer.

The effect of this regarding student satisfaction and enhanced learning outcomes, will be investigated using qualitative methods of inquiry and analyzis.

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# Promoting Intercultural Communication via a Series of Online Micro-Learning Modules

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**Abstract:** In view of the global trend of internationalisation, and aiming specifically to support our students on their exchange programmes and to enhance cultural integration on campus with an increasing number of international students, the Independent Learning Centre (ILC) at The Chinese University of Hong Kong has produced a series of online micro-learning modules titled "*Interacting Across Cultures.*" While there are free online learning resources available helping students to improve their understanding across cultures to enable them to benefit from the exchange experience at the academic, linguistic, personal and cultural levels, most of them are mainly from low-context cultures, such as the United States, preparing students for stays in other cultures. Very few, if any, resources are available to cater to the needs of students from high-context cultures, such as Hong Kong and China. Seeing such a gap and motivated by recent research which suggests that meaningful pre-departure preparation significantly increases the value of students' study abroad experience (e.g. Hammer, 2012), the ILC has therefore created a series of five micro-learning modules on the following topics: What is Culture? / Communication Styles / How to Achieve Your Goals / Culture Shock and Other Obstacles / How to Make Sense of Intercultural Experiences. Interested students can complete them anytime, anywhere, and at the pace they are most comfortable with. The content is accessed via interactive webpages on desktops and mobile devices. Supported by appealing visuals, interactive exercises, reflection activities as well as further independent learning resources, the modules can benefit not only departing students, but also all students who want to integrate better with students who come from a different cultural background on campus or who want to increase their cross-cultural understanding for their future career. This paper describes the need for the creation of the modules, the development of their content, as well as some of the design challenges that had to be overcome in the process.

**Keywords:** e-learning; design; micro-modules; intercultural communication; study abroad; Hong Kong

## 1. Introduction

The past 25 years have witnessed the internationalisation of higher education in many parts of the world. And one of the major indicators of this global trend is evident in the increasing number of university students participating in study abroad programmes, which range from a few weeks to a full academic year, as part of the fulfilment of their academic degrees. Statistics indicated that between academic years 1987/88 and 2011/12, the number of students studying abroad through Erasmus, the largest educational exchange programme for higher education students in the European Union, had increased from 3,244 to more than 250,000 students (Available online at ec.europa.eu/education/library/reports/erasmus1112_en.pdf). And according to the Institute of International Education, in academic year 2011/12, 283,332 students in the United States studied abroad, representing almost a 500% increase, since academic year 1985/86 (as cited in Di Pietro, 2014). In Hong Kong, internationalisation of higher education and broadening local university students' horizons by providing them with quality exchange and study abroad opportunities have been a recurrent theme in the recent reports by the University Grants Committee (UGC), a body which determines how financial resources of the government are to be used and distributed among publicly funded universities in the territory (UGC Report 2010 : "Aspiration for the Higher Education System in Hong Kong" Available online at http://www.ugc.edu.hk/eng/ugc/publication/press/2010/pr01122010.htm). In the Chinese University of Hong Kong (CUHK), for example, the number of outgoing and incoming exchange students is reported to have hit a record high in 2014/15 – a total of 1,170 students were sent out and 1,019 students were received from more than 240 exchange partners in 34 countries during the term time (Executive Summary, Annual Report of the Office of Academic Links: 2014-2015, CUHK, available at: https://www.cuhk.edu.hk/oal/restricted/staff/OAL_Annual_Report_14-15.pdf; Facts and Figures 2014, CUHK, available at: http://www.iso.cuhk.edu.hk/ebook/index.html#ui=en&page=18&issue_id=1470&lang=en). Apart from increasing and diversifying exchange and study abroad opportunities, every effort has been made to internationalise the student population on campus. In 2014-2015, more than 1,800 non-local students were admitted into either the three-year or the four-year undergraduate programmes at CUHK and these students came from Australia, Belgium, Germany, India, Indonesia, Japan, Korea, Kyrgyzstan, Malaysia, Nepal, Portugal, Russia, Swaziland, Thailand, the United States, Macau, Taiwan, and 31 provinces and municipalities in Mainland China. Helping the non-local students to integrate into the campus life in a comprehensive university such as

CUHK and preparing departing students for meaningful experience during the study abroad programmes is an important task for us all at the university.

## 2. Background

The idea of developing the "*Interacting Across Cultures*" online micro-learning modules first came from the Independent Learning Centre (ILC)'s experience in delivering a 2-hour face-to-face workshop titled "*Make the Most of Your Study Abroad Experience*" for departing exchange students upon the request of the Office of Academic Links (OAL), which is the unit that coordinates all student exchange programmes at the CUHK, in the fall semester of 2015. This was to provide additional support on top of the very comprehensive services that the OAL has been offering to all departing students before their departure, during their overseas stay, and upon their return to Hong Kong. In the pre-departure briefing sessions, students are usually provided with practical information about the overseas universities, accommodation arrangements, as well as tips to survive in a different culture to help them plan and prepare for their study abroad programmes. Ties with students during their stay overseas are maintained via e-newsletters. Upon their return, students are asked to report and share their experience with other interested students. A writing contest is also organised to encourage returning students to reflect on their study abroad experience (For details of the full range of services and support the OAL offers, please visit http://www.oal.cuhk.edu.hk/).

While the face-to-face workshops were usually fully subscribed by the departing students and often received very good student evaluation, it was noted that although multiple sessions were offered, it is difficult to accommodate all students' timetables. Furthermore, the ILC has also seen the need to support students on campus to help them integrate better with the non-local students in an increasingly internationalised university through raising their intercultural awareness and enhancing their cultural competence.

## 3. Developing content for Hong Kong and mainland Chinese students

The first step was formulating desired outcomes so that the micro-modules would enhance the learning and integration of CUHK students selected for exchange programmes, as well as the cultural competence of other interested students on campus. It appeared early on that to achieve such goals the content would have to go beyond intercultural communication and adopt a more holistic approach that would also include suggestions for the development of academic, linguistic and personal knowledge, skills and attitudes. Based on the works of Hurn & Tomalin (2013), Jackson (2010), Olson et al. (2006), Ward et al. (2001) and Yook (2013), five specific development areas were identified: cultural awareness, intercultural communication, goal-setting, obstacles to intercultural interaction, and self-reflection. Each area would be covered by one module, by the end of which learners would be able to:

- Cultural awareness
- *recognise cultural differences in terms of norms, values and beliefs*
- *analyse cultural differences based on major cultural models*
- *expand their cultural knowledge independently*
- Intercultural communication
- *distinguish between low-context[1] and high-context[2] communication styles*
- *identify and adapt to other communication style differences across cultures*
- *interpret verbal and non-verbal messages from multiple cultural points of view*
- Goal-setting
- *formulate realistic expectations regarding exchange and intercultural experiences*
- *identify and select academic, linguistic, personal and cultural goals for learning abroad*

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[1] In low-context cultures, the expected communication style is direct, precise and detailed, based on the assumption that the context of communication does not provide enough information for the message to be clear without a high degree of explicitness. Low-context cultures include German, Dutch, Scandinavian and North American cultures.

[2] In high-context cultures, the expected communication style is indirect, implicit and suggestive, based on the assumption that the context of communication already provides a lot of information and clues for the message to be clear without the need for explicitness. High-context cultures include Japanese, Chinese, Korean and Arabic cultures.

- *formulate, select and apply relevant strategies to reach their goals*
- Obstacles to intercultural interaction
- recognise culture shock and its symptoms in themselves and others
- identify other personal and cultural obstacles to reaching their learning goals
- formulate, select and apply relevant strategies to overcome those obstacles
- Self-reflection
- apply the self-reflective writing process
- select the self-reflective format best suited to their preferences
- critically examine their experience during and after exchange or intercultural experiences

To enable learners to reach these objectives, each module combines text, visuals, short animated videos, interactive tasks such as critical incident analysis, multiple choice questions and matching exercises, as well as pop-up feedback on students' answers and choices. Other activities include the creation of a personalised action plan, as well as self-reflection and an assessment of possible threats to success.

The target learners being Hong Kong and mainland Chinese students with a high-context communication style, the question of how to adapt the content to their needs arose early on as well. Among the elements constituting the modules, critical incident analysis stood out as the task that would benefit the most from an adjustment to high-context communicators. Most situations presented in the modules therefore feature a high-context communicator as the main agent interacting with lower-context communicators, matching the type of situation in which CUHK students regularly find themselves. Each critical incident analysis task, however, does not simply enable learners to project themselves into potentially difficult situations from a high-context point of view, but it also asks them to interpret the situation from the point of view of the lower-context communicators by providing several interpretations to choose from for both high-context and low-context communicators. This results in a three-step process for learners: first approaching the situation as they would in reality as they read about it, then explicitly identifying one character's view of the situation in a multiple-choice question task before finally interpreting the situation from a different character's viewpoint in another multiple-choice question task, each choice generating pop-up explanations.

## 4. Aligning online experience with individual learning preferences and overall learning objectives

One of the main challenges in the development process was aligning the navigation and interaction of the website with the desired learning outcomes while respecting a variety of learner preferences. On the one hand, the site had to be engaging enough for learners to complete the modules entirely on their own. On the other, the content presentation and interactive tasks had to foster learning, not distract from it, and adapt to diverse learner levels.

In terms of navigation control, a point-by-point scroll-down linear structure with a pop-up side menu was chosen so as to accommodate the preferences of learners with different levels of prior knowledge of the topics. As evidenced by student input during intercultural communication workshops run by the ILC prior to the development of the micro-modules, some learners are already familiar with the major concepts in intercultural communication, while others have no prior knowledge of the topics at all. This resulted in a dilemma regarding the level of control learners should have over the modules' flow. As Clark & Mayer (2011, p.309) point out, "learners with higher prior knowledge can typically make good choices under conditions of high learner control. However, most novice learners often don't know enough about the content domain to benefit from learner control." It was eventually decided that the main navigation mode would be designed with novice learners in mind, while a discreet side menu would function as progress tracker and optional control centre to allow more advanced learners to jump to any topic or task (see Figures 1 and 2).


**Figure 1:** Screen capture showing left-hand side menu with red tick indicating progress


**Figure 2:** Screen capture showing left-hand side menu with rollover indicating section title

Point-by-point scroll-down navigation offers two additional advantages. First, it also allows for effective content sequencing in all sections. Regardless of learners' section choice, each scroll reveals one complete learning point or task at a time, so that all relevant information appears on one screen only. Further scrolling within the same screen is occasionally required to reveal additional information, but learners never have to scroll back and forth between two screens or parts to see all the relevant information, and no screen features more than one point or task. Second, scroll-down navigation gives learners complete control over pacing. Novice learners can take all the time they need to assimilate new points or complete tasks, while more advanced learners can speed through points they are familiar with or simply wish to review.

The design of interactive tasks had to be equally relevant to the learning process and, as much as possible, reinforce it. The development of the critical incident analysis tasks, simply called "scenario analysis" in module 2, presented the perfect opportunity to apply and test this principle. One of the purposes of these tasks is to train learners to change their mindset about a given situation and see it from different cultural points of view. In order to reinforce this process, the tasks were designed to literally make learners change points of view to complete them. As described above, the critical incident analysis tasks involve three steps: reading about the situation, identifying the way one of the characters sees it, and identifying the way a character from a different culture sees it. To move from the second to the third step, learners have to click or tap a "change point of view" box, which visually shifts the focus to the other character and reveals the corresponding set of possible interpretations of the situation. A change in the background colour of the feedback box accompanies the shift and reflects the filtering of the situation through the lens of a different culture (see Figures 3 and 4).


**Figure 3:** Screen capture showing Chinese student point of view with possible interpretations

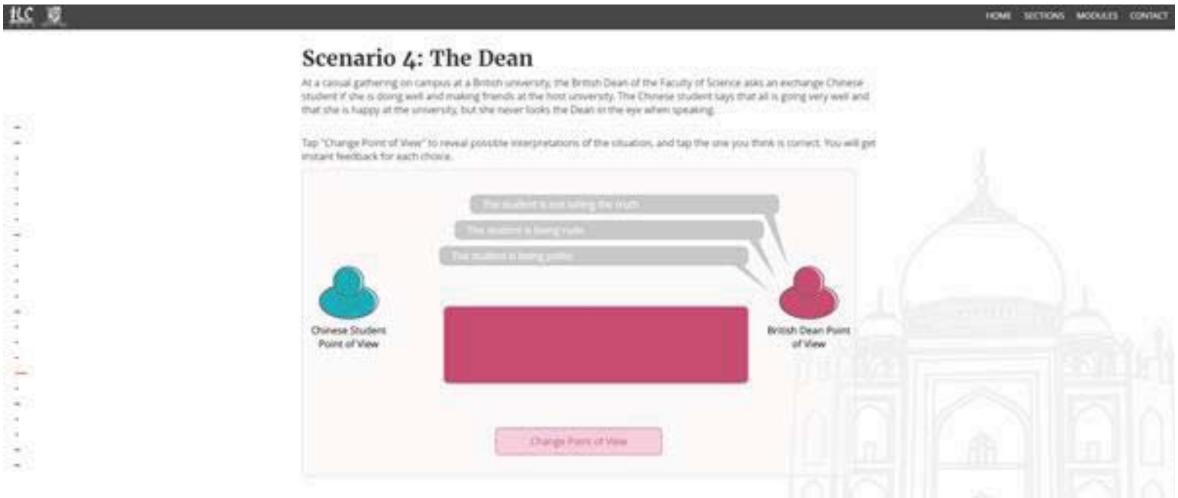


**Figure 4:** Screen capture showing British Dean point of view with possible interpretations

Another feature that results from the application of the design and outcomes alignment principle is the "My Commitment" feature of module 3. This feature includes a series of menus with selected goals and strategies combined with free input text boxes (see Figures 5, 6 and 7). This allows learners not only to discover categories for improvement and select or formulate their own set of objectives, but also to create a personalised action plan by matching specific goals with specific strategies. It further prompts them to commit to their action plan by having it sent to the email account of their choice. Together with "top tips," these elements reinforce several essential learning points. First, the benefits of intercultural experiences are much more specific than the broadening of horizons so often given as the reason to go on exchange programmes. Second, gaining any of those benefits takes more than simply being in a foreign country or in the presence of foreigners. It takes a conscious and deliberate effort, as well as careful selection. It takes a game plan. Finally, one has to selectively spend one's time, money and energy on activities that match the game plan if one hopes to benefit from the exchange or intercultural experience.

Making sure that information presentation supports knowledge acquisition is a basic principle that should apply to every element of e-learning. As the following section makes clear, however, even simple matters such as whether to present information horizontally or vertically can be surprisingly problematic when the time for web development comes.


**Figure 5:** Screen capture showing interactive core competencies table


**Figure 6:** Screen capture showing interactive goals menu

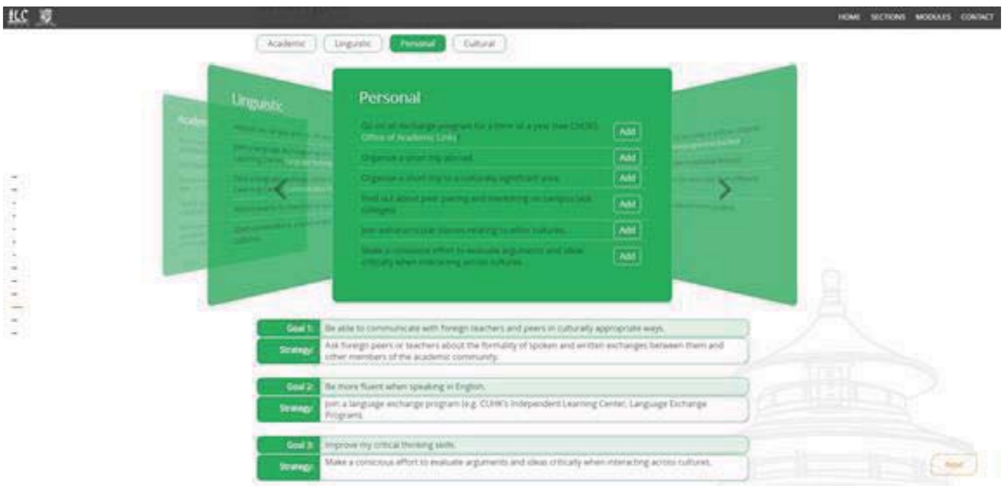


**Figure 7:** Screen capture showing interactive strategies menu

## 5. The contrasting visions of content and web developers

Ensuring that the web development of the learning platform matches its pedagogical vision is another challenge in the development process of micro-learning modules. Two choices were available. The first meant outsourcing the development of the platform to another unit on campus, while the second meant relying on in-house development by the ILC's IT expert. Budget considerations only marginally informed the decision to go for the second choice. The main reason to choose in-house development was to maximize control over the design of the modules, not to mention communication opportunities. From the onset, content and web developers therefore worked in close collaboration, sharing ideas and exploring existing websites to define the overall direction of the project in terms of design and interface. This was achieved even before any content had been developed and it undoubtedly saved much time and effort in the long run. Despite this early consensus, the micro-module project made it clear that even in such proximity the relationship between the content developer and the web developer is far from symbiotic. Simply put, the content developer and the web developer have a different set of problems to solve, and the solutions that the latter finds can undermine the former's intentions. When learners would benefit from remembering a ranking, for instance, the information is usually presented vertically, to make it easier to retain by having the visual order match the information. In this case, this applies to how countries are presented on the low-context / high-context spectrum, as well as to the presentation of major countries' scores on Hofstede's six dimensions of culture (2010), for instance. However, applying the design and outcomes alignment principle even in cases as simple as these was not straightforward at all. Screen size questions combined with the web developer's interpretation of the content actually resulted in a first version featuring a horizontal low-context / high-context spectrum (see Figure 8):

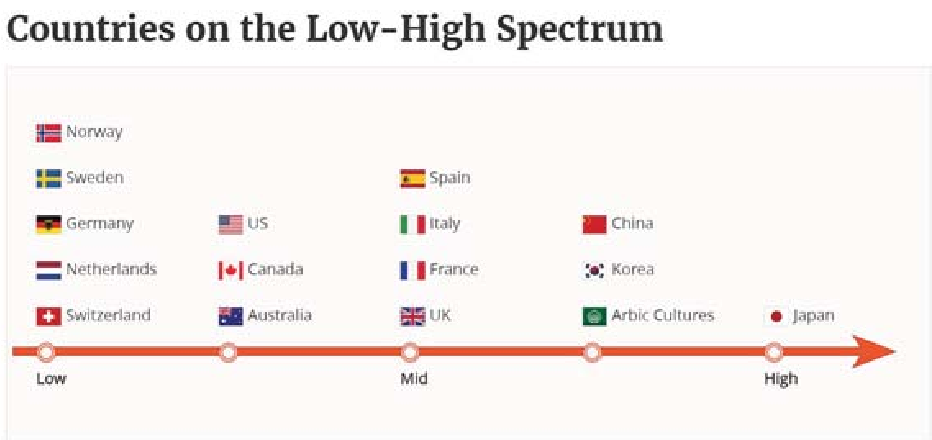


**Figure 8:** Screen capture showing original horizontal version of low-context / high-context spectrum

An attempt at using the countries' Hosftede scores to create an interactive task led to an even more confusing first version for that section. Learners had to find each country's score by tapping the correct one until answers were revealed, with rankings given in a random order (see Figure 9):

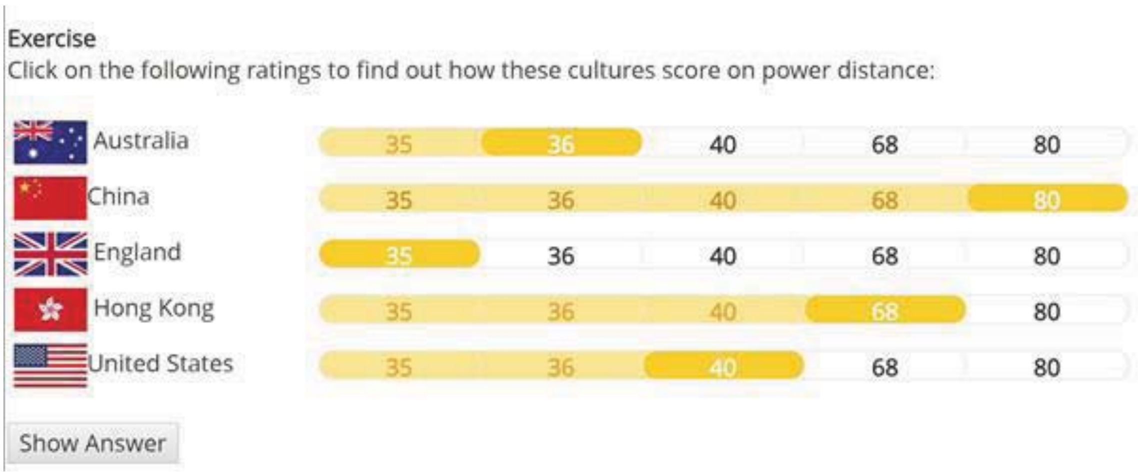


**Figure 9:** Screen capture showing original version of Power Distance scores

It was only after the pedagogical and cognitive reasons for a simple ranked vertical presentation were explained that web design and learning objectives could be matched in both cases (see Figures 10, 11 and 12):

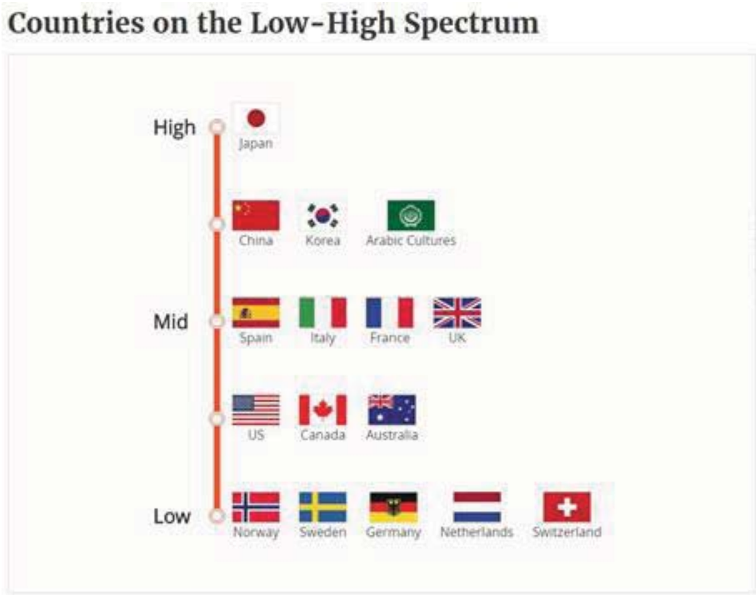


**Figure 10:** Screen capture showing final vertical version of low-context / high-context spectrum

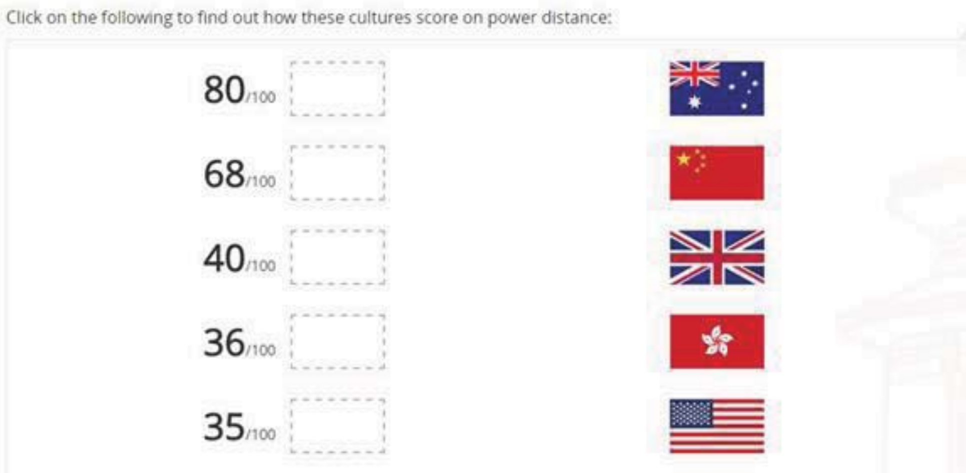


**Figure 11:** Screen capture showing final version of Power Distance scores before click / tap


**Figure 12:** Screen capture showing final version of Power Distance scores after click / tap

In other words, the first versions benefited from a more convenient and visually appealing design and more interesting interactive possibilities from a web development point of view, but from a pedagogical point of view they interfered with learning and retention, so they had to be modified. Conversely, what would pedagogically make sense does not always work in terms of web development. Most tasks that had to do with structure and order were initially conceived as drag and drop tasks, for instance, given that restructuring content by manipulating it into the correct order on a screen can be seen as reinforcing learning and retention. Due to the variety of devices and screens on which the modules have to be functional, however, drag and drop had to be abandoned in favour of toggles and animations. In the end, this project succeeded thanks to the open dialogue and flexibility at the heart of the collaboration between content and web developers working in the same unit. They may speak different languages and see the tasks at hand from different points of view, but a common vision established early on in the service of students gave the developers a clear goal to reach and their proximity in the same office space gave them enough communication opportunities to react quickly to any misalignment between web design and learning objectives.

## 6. Conclusion

The paper begins with the motivation behind the development of the online micro-learning modules *"Interacting Across Cultures"* by the ILC at the CUHK. Seeing that most online learning resources are mainly developed in countries with low-context cultures and that most of them mainly focus on raising students' awareness of intercultural communication, we therefore developed our own *"Interacting Across Cultures"* which (1) includes scenarios that invite students to adopt points of views typically held by people from the low-context and high-context cultures respectively; (2) adopts a more holistic approach that also includes suggestions for the development of academic, linguistic and personal knowledge, as well as skills and attitudes, and (3) emphasises the importance of student commitment, goal setting and independent learning on a continuous basis. Through describing the content of each of the five online micro-learning modules, we illustrated how individual learning preferences were aligned with the overall learning objectives with examples, and the challenges regarding the different concerns of the course and web developers respectively. *"Interacting Across Cultures"* was piloted in September 2016 and the modules were mainly completed by departing students of the exchange and study abroad programmes at present. User feedback is now being collected via the web and in focus groups. We are also currently actively exploring various possibilities with different units on campus to get more students on our increasingly internationalised campus to study the online learning modules for cultural integration purposes. We believe heightened intercultural competence will not only benefit students academically in the short term, but also benefit them professionally after they have graduated from the university.

## Acknowledgements

The completion of *"Interacting Across Cultures"* would not have been possible without the joint efforts of staff members at the Independent Learning Centre of the Chinese University of Hong Kong. Special thanks should go to Mr Rodney Ho, our web developer, for his technical support and Dr Felix Chao for his valuable input throughout the development process.

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# Open Badges: Acknowledging Soft Skills Acquisition

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**Abstract:** In 2010 the Mozilla Foundation established the Digital Open Badges concept as a virtual incarnation of physical counterparts such as a paper certificate or a youth organisation merit badge. *Digital* Open Badges offer embedded, verifiable, metadata containing information such as the issuer and award criteria. Open Badges can be used to reward learning, participation or achievement. They can be stored in various online environments, including the Mozilla 'Backpack' and social media platforms. Open Badges have been used to evidence informal learning, professional development, community and voluntary work. This study is part of an ongoing project at a UK Higher Education Institution (HEI) to evaluate the potential of awarding Digital Open Badges in different contexts across the institution. It was decided to trial Open Badges on a programme run by Learning Development staff in the Library to support high achieving students, acknowledging and rewarding soft-skills acquired as part of the programme. Central to the success of the scheme was 'buy-in' from the students themselves; in order that the Open Badges had meaning and value to the recipients, a Participatory Design approach was adopted to engage students in the development process. Participatory Design is an iterative methodology that 'attempts to examine the tacit, invisible aspects of human activity' (Spinuzzi, 2005, p. 164) and incorporates them into co-produced systems. Soft-skills are an important complement to formal education in the 21st Century workplace (Devedžić *et al.*, 2015). Measuring and rewarding 'soft-skills' such as; critical thinking, communication, leadership and team-working, has proved problematic in the past. Key objectives were to establish a set of soft-skills metrics and, a sustainable approach to acknowledging the acquisition of those skills. This presentation will discuss the outcomes from the study, including an assessment of the sustainability of Open Badges as a mechanism for rewarding soft-skills acquisition in an informal setting.

**Keywords:** open badges, participatory design, soft skills

## 1. Introduction

Open badges are attracting increasing interest within UK Higher Education. However, their nascent state means that most implementations are merely digital replications of existing paradigms. We are starting to explore methodology testing the boundaries of existing usage, which we believe will be of interest to other practitioners.

This study is part of an ongoing project at the University of Surrey, a UK Higher Education Institution (HEI), to evaluate the potential of awarding Digital Open Badges in different contexts across the institution. It was decided to trial Open Badges on the STARS programme (Surrey's Top Achievers Recognised and Supported) run by Library and Learning Development staff to support high achieving students, acknowledging and rewarding soft skills acquired as part of the programme. Central to the success of the scheme was 'buy-in' from the students themselves; in order that the Open Badges had meaning and value to the recipients, a Participatory Design approach was adopted to engage students in the development process. Participatory Design is an iterative methodology that 'attempts to examine the tacit, invisible aspects of human activity' (Spinuzzi, 2005, p. 164) and incorporates them into co-produced systems.

The participatory process for this project entailed an iterative cycle of focus groups, surveys and prototyping, with each activity feeding forward into the next. The result was a co-produced framework of badges designed to engage students, rewarding them for participation in STARS events and maximising the value in terms of evidencing soft-skills to potential employers. Subject to the success of the badging framework with the STARS students, the intention is to roll it out across the institution.

Soft skills are an important complement to formal education in the 21st Century workplace (Devedžić *et al.*, 2015). Measuring and rewarding 'soft skills' such as; critical thinking, communication, leadership and team-working, has proved problematic in the past. The key objectives in this project were to establish a set of soft skills metrics and, a sustainable approach to acknowledging the acquisition of those skills.

This presentation will discuss the outcomes from the study, including an assessment of the sustainability of Open Badges as a mechanism for rewarding soft skills acquisition in an informal setting.

## 2. Background

### 2.1 Open badges

In 2010 the Mozilla Foundation established the Digital Open Badges concept as a virtual incarnation of physical counterparts such as a paper certificate or a youth organisation merit badge. Digital Open Badges offer embedded, verifiable, metadata containing information such as the issuer and award criteria. Open Badges can be used to motivate and/or reward, learning, participation and achievement. They can be stored in various online environments, including the Mozilla 'Backpack', institutional virtual learning environments (VLEs) and social media platforms such as LinkedIn. A lot of the impetus for open badging originated in online role-playing games in which users 'levelled-up' by acquiring various virtual attributes or powers, this system proved to be a powerful motivating force for players (Manninen and Kujanpää, 2007). This structure of acquiring a number of badges at one level which then 'unlocks' badges from the next level forms the basis of many open badging eco-systems.

Open badges have been used to evidence informal learning, professional development, community and voluntary work. Open Badges now form part of what is now being referred to as the micro-credentials movement which also includes things such as, Udacity's nanodegree and various professional development certificates which are used represent much smaller discrete elements of learning or achievement rather than a traditional formal qualification such as a degree programme.

The long term sustainability of badging initiatives seems positive as, even if individual schemes fold, the badges themselves are portable and retain all the relevant information. Gartner, an influential information technology research and advisory company reported that while 'open micro-credentials [are] still relatively immature as a technology, [they are] gaining traction in the education community. Gartner sees it as a clear strategic technology with a relatively small investment involved, thereby making it a low-hanging fruit with good ROI' (Moore, 2015).

### 2.2 Participatory design

Traditional user-centred design processes consulted and studied end-users which revealed explicit and observable phenomenon. The change from a user-centred design process to that of participatory experiences 'is a shift in attitude from designing *for* users to one of designing *with* users'(Sanders, 2002, p. 1). The result is an approach which draws out tacit knowledge and latent needs, adding considerable weight to any final outcomes. Originally developed in an increasingly complex and amorphous computer industry to specify hardware and software design requirements, Participatory Design (PD) methodology endeavours to empower and involve end-users throughout the design process to ensure that the final product is fit for purpose.

More than simply 'add users and stir' (Muller, 2003, p. 3) the PD approach has 'a pervasive concern for the knowledge's, voice's, and/or rights of end-users' (ibid). The underlying aims of, questioning assumptions, mutual learning and synthesising ideas is realised through an iterative prototyping and collaborative process.

In line with the ideal of a 'continual relationship that is marked by iterative meetings' (Sanders, Brandt and Binder, 2010, p. 197), this project involves an ongoing collaboration with student groups involving regular meetings and activities, to produce a range of open badges which maximise their potential, both in terms of desirability to acquire them from the student perspective and, their impact with third parties such as employers. The involvement of students confirmed some of our assumptions, but challenged others and therefore provided crucial direction during the design process. The co-production ethos of this project extends to this paper which includes a student as one of the authors.

## 2.3 STARS programme for high achieving students

At the University of Surrey, a differentiated student support programme has been running in the Library and Learning Support service since 2011. The STARS ('Surrey's Top Achievers Recognised and Supported') programme is available to high achieving 2nd & 3rd year students. At its inception one of the aims and objectives of the STARS programme was to redress student perceptions of learning development support as a remedial service. Approximately 2900 students are eligible to join each year and 80% of these eligible students interact with the scheme through the online VLE. The programme is designed to engage high achieving students in opportunities for personal and professional development. Bespoke events and activities are designed in response to heuristic research exercises; these include advanced leadership days, developing resilience, authentic networking in addition to providing access to an online community and 1:1 coaching sessions. On average, 10% fully engage and participate in the organised activities

Results from the inaugural year indicated students themselves saw the top 3 benefits of participating in the programme as increased engagement in support; recognition of achievement and skills development (Dickinson and Dickinson, 2015). Feedback comments from student participants included:

> *'It makes me feel that the hard work is worth it. And it's good for my CV.' 2015*

A key attribute of the STARS programme is 'recognition' and, historically this was achieved through the presentation of paper certificates. They were deemed a high priority with 55% of students who responded to a survey in which they stated that receiving the certificates was one of the main reasons why they wanted to participate in the programme. Yet there was no student involvement in the design of these certificates and the administrative process was onerous and costly. In response to advancements in technology it was decided to adopt an online badge system to replace the paper certificates. An early perception was that this would meet the students' needs of evidencing their soft skills through social media platforms, such as LinkedIn. This reasoning was validated following consultation with students in focus groups and an online survey whereby 96% of responses indicated they wanted to 'To share with potential employers via job applications or CVs' and 54% of responses: 'To share publicly on social and professional networks'. The existing relationship between STARS students and university of staff provided an ideal environment for exploring the potential of digital badges through student consultation.

## 2.4 Soft skill recognition

During the first STAR event of each academic year students are asked to identify areas they wish to develop. This needs analysis provides data which informs the programme of events for the year. It is apparent that the needs identified by STARS students have remained fairly consistent since the inception of the STARS programme.

This can be seen by comparing the needs analysis from 2011/12 and 2015/16.

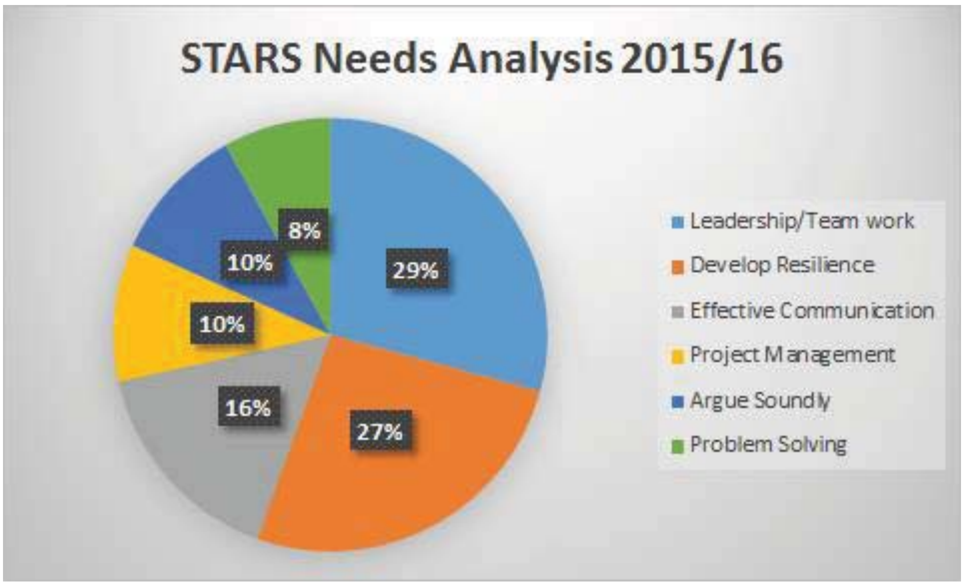


**Figure 1:** STARS needs analysis

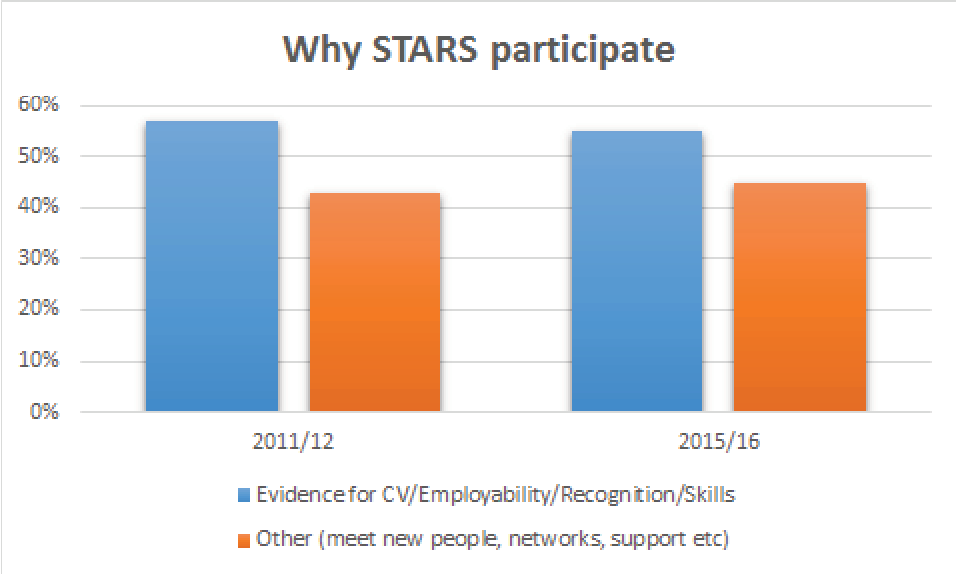


**Figure 2:** Why STARS participate

Results from the needs analysis carried out in November 2015 demonstrate students' desire to provide evidence of transferrable soft skills such as leadership and resilience (see Figure 1); in the academic year, 2015/16, 55% engage with the programme in order to acquire such evidence (see Figure 2) with 56% identifying these two particular skills as a priority (29% and 27% from Figure 1). A key factor was the belief that recognition of these attributes would enhance employability opportunities:

> *'Improves employability, something not everyone will have on their CV;'*
>
> *'to set me apart from others competing for the same career';*
>
> *'to gain an competitive advantage over my peers' (2015).*

There is an expectation amongst students and HE institutions that soft skills recognition amongst employers will gain traction in the coming years; 'one corporate research paper found that Fortune 500 senior hiring managers believe digital credentials would "ease a pain point for many employers"' (Grant, 2014, p. 29). In niche markets there are already examples of 'potential employers [who are] willing to pay handsomely to be put in touch with the rare individuals who have earned the highest level badges' (Hickey *et al.*, 2014, p. 20)

Students have defined which soft skills they wish to gain and evidence, through the heuristic needs analysis research. Soft skills, according to Galllivan, Truex and Kvasny (2004) cited in Gibb (2014, p. 456) are defined as: 'communication skills, interpersonal skills, organization skills, leadership skills, self-motivation skills and creativity skills'. These are consistent with the needs identified by the students in the initial heuristic research exercise.

## 2.5 Badging contextual to STARS

The online badge system created an opportunity for full student participation for recognition of soft skills gained through the STARS programme. This approach is supported by Gibb's (2014) research into soft skills assessment which finds that: '...it is not only about completing a programme or training event, it is necessary for integration into communities of learning and work' - therefore the opportunity for students to participate in the design and implementation of the STARS online badges enabled them to identify criteria relevant to themselves rather than employing a formative assessment model.

A consideration when developing badges is the introduction of assessment criteria for student identified soft skills, further research is planned, through the participatory model, to define the requirements for supporting evidence.

### 2.6 Outcome/impact

Based on an internal (unpublished) report, an expected outcome from the introduction of an online badge system, developed through full participatory model, is the enhancement of student self-efficacy by their taking responsibility and control of their own learning progress, particularly in the area of recognition of pre-defined soft skills.

## 3. Methodology

This ongoing mixed methods study comprises of three phases in an iterative cycle. All of the participants were drawn from active members of Universities STARS programme, consisting of two-hundred and forty-two, 2nd and 3rd year students who are currently working at a 2:1 level or above. The participants completed consent forms. However, due to the nature of the research and, as no personal details were recorded at any point, the University ethical self-assessment online tool indicated that ethical approval was not required.

### 3.1 Focus group sessions

In order to establish student attitudes and aspirations towards open badges, two focus group sessions were held. The first addressed the broader issues of motivation, evidence and structure, while the second, which was conducted after the online survey, dealt with more granular aspects of the first prototype open badge framework such as, 'levelling-up' criteria and badge design.

The data from the focus groups was collected by one of the four facilitators and analysed using thematic analysis (e.g. Braun and Clarke, 2006).

### 3.2 Online survey

The goal of the survey was to validate some of the results obtained from the qualitative data by consulting a larger group of students, testing some of the conclusions reached by the students who took part in the initial focus group. The sample consisted of the two hundred and forty-two active STARS students. They were invited to complete the survey via email. As open badges have not been previously advertised by the university, the email also included general information about the digital badges such as what they are and how they could be used. As an incentive to take part, students were offered the chance to earn their first digital badge by completing the survey.

The results from the first round of this iterative cycle are discussed and contextualised in the following section.

## 4. Results and discussion

### 4.1 Findings from student focus group

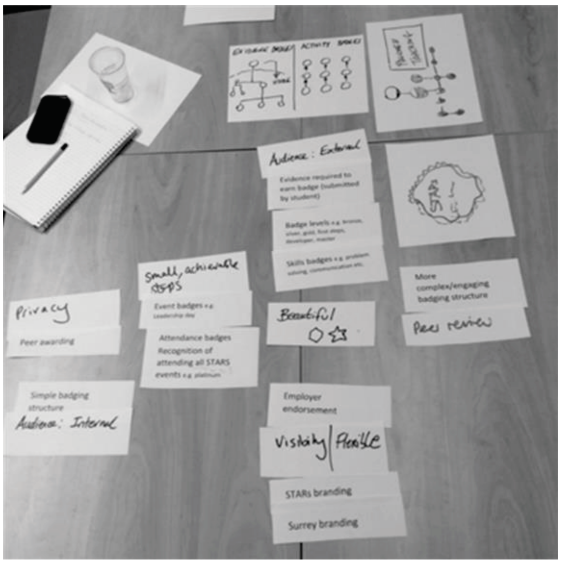


**Figure 3:** Grouping, ranking and discussing aspects of badge design

Five main themes became apparent during the focus group discussions. The content of the discussions is presented here according to the relevant theme.

### 4.2 Visibility and privacy

When discussing how much detail was available to the badge viewer, student participants in the group said that where higher badges have been earned they would like the journey to be visible. They felt that visible detail was important because badges are more personal than certificates and official qualifications as they link evidence describing what earner did. Students also said that it was essential that the meaning of badges is clearly visible to employers. Privacy was not an issue at all to the students consulted. Indeed, they said they would want badges to be as visible as possible.

### 4.3 Availability and design

Students suggested that there could be event or attendance-based badges alongside skills-based badges. They felt that attendance-based badges would be quantitative in nature whereas skills-based badges would be more qualitative. Students felt that University of Surrey branding is important whereas STARS branding is less important. They suggested that there could be additional badges just for STARS students. Students were keen for their peers to be consulted on what badges should be available, and what the badges should look like. Students felt strongly that the aesthetic of the badges was important.

### 4.4 Participation and motivation

Participants pointed out that as many students experience high workloads and often feel pressured, it is important that badging does not exacerbate this; it must stay fun and flexible. However a more complex and engaging structure was preferred over a simple one as this was perceived by the students to be more motivating and fun. Students said that employer endorsement is very desirable and will be a key driver of participation. Students were keen for all students to be able to participate in a badging scheme, but recognised the benefits of piloting the project with STARS students.

### 4.5 Structure and levels

Students felt a complex structure, with levels, would mean an increased sense of satisfaction upon earning a badge, or moving up a level. However there was some concern about students being disinclined to display a badge which identified that they had achieved but only at a low level. Students suggested they may wish to keep the badge private until they had reached a higher level, at which point their badge earning 'journey' through the levels would become publicly visible.

### 4.6 Earning and evidence

Students were keen that there were be opportunities other than STARS events to earn badges, as they recognised that not all students could attend events. They suggested that students should have to submit some kind of reflection as evidence to earn event badge, rather than simply attending. Students felt strongly that evidence submitted should be specific and quantifiable.

Students said that most badges should require significant effort to earn to maintain an element of exclusivity. They were concerned that badges may be devalued if they can be too easily earned. However the students felt that some badges should be simple and fairly easy to achieve. Students suggested that evidence could be peer-reviewed, or supported by peers. Students considered finding a way to quantify time or effort spent on working towards a badge but were aware that not everyone works at the same pace.

### 4.7 STARS online survey: Emergent themes

The response rate to the survey was 24%. It is worth mentioning that the survey was sent out during revision week without any prior advertising. Thus, it could be that because fifty-seven people voluntarily engaged with this new, pilot project, and six of them offered to provide further support and feedback, the students' initial reaction to the Open Badges programme was a positive one.

### 4.8 Motivation to use badges

The vast majority (91%) of the students said that it was equally important for them to be able to earn badges which acknowledge their attendance at STARS events and to demonstrate the acquisition and improvement of soft skills, such as resilience and creativity. This was the case irrespective of whether they have attended a STARS event or not. A large proportion of the people surveyed (70%) reported that their motivation to use badges would be to receive recognition for the activities which they carried out as part of a student society or STARS programme. Four participants said that they would like to earn badges which could reflect their volunteering activities, and achievements such as the highest marks in class and activities carried out as a course representative. Also, one of the respondents suggested that the badges should have the capability to reflect 'levels' and offered the example of gold, silver and bronze badges.

### 4.9 The effort required to submit evidence

The findings highlight that the majority of students (89%) would prefer to use work that they have already completed as evidence when applying for a badge whereas 61% said that they would also be willing to create new, but brief evidence such as a short written reflection, a video or a photo.

### 4.10 The importance of accreditation

For most respondents, university accreditation was an important component of the online badges, although, 75% of the students reported that both STARS and the University of Surrey branding were important parts of the badge design. Furthermore, 73% declared that having their badges endorsed by employers is very important.

### 4.11 The display of digital badges

Most of the students (96%) said that they would prefer to share digital badges with potential employers via job applications or their CVs. More than half of the participants (54%) said that they would share them publicly through social and professional networks. On the other hand, a significant percentage of the sample said that they would also use badges to reflect upon personal activities such as recording achievements and keeping track of progress for themselves as part of an online personal development portfolio.

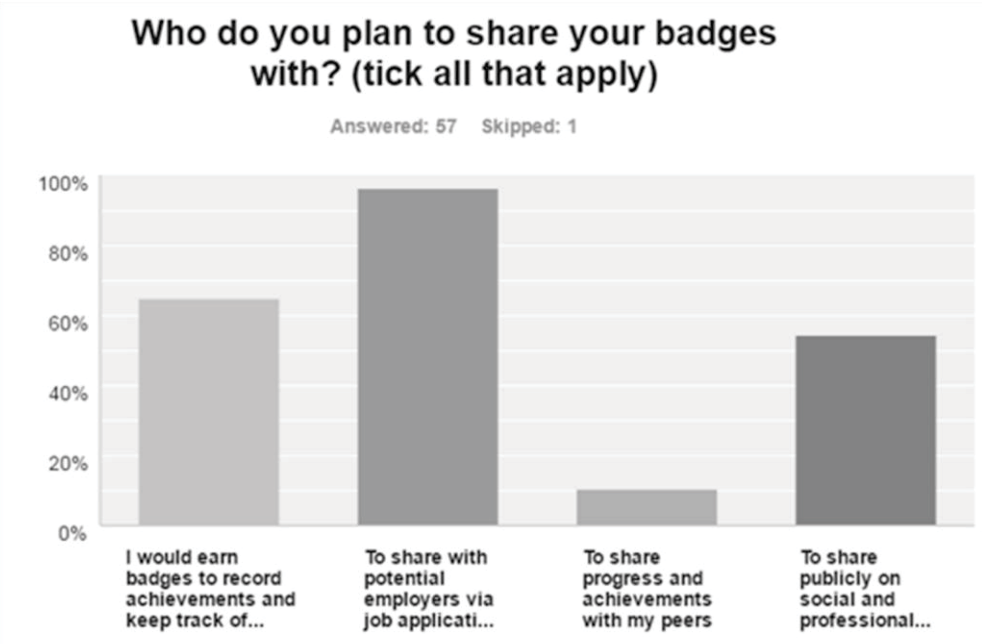


**Figure 4:** How students think they would use the badges.

### 4.12 Using badges for peer endorsement

Only 11% said that they would not consider using badges to endorse peers on the STARS programme. However, nearly half of the participants (49%) reported that they would award badges to other students while 40% acknowledged that they were not sure whether they would endorse other people.

## 5. Conclusion

Fierce competition among the top candidates, along with ubiquitously high grades in formal education, is leading employers to look at a broader range of metrics when assessing for recruitment. As a result, evidencing the existence of, or acquisition of, soft skills such as leadership and resilience are becoming more of an issue for high achieving students in tertiary education. This project therefore set out to develop a suite of digital open badges which would allow students to easily demonstrate their proficiency in various soft skills to third parties such as, potential employers. Digital Open badges contain verifiable metadata outlining the conditions under which the badge was awarded and the issuer, in this case, the University. A participatory design approach was taken when developing the open badge framework to ensure that the student voice permeated the process, while encouraging them to develop a sense of ownership.

It became evident when this project commenced that few students were aware of micro-credentialing or the open badging movement. However, participants almost immediately assimilated the concept and keenly embraced its potential for enhancing their digital professional identity and, improving their employability. We do not therefore see the current lack of awareness amongst students as a significant barrier to the success of an open badges credentialing system.

The participatory design approach adopted for the project has been hugely influential in guiding the direction and focus of the open badges eco-system. Assumptions made about the complexity of such systems were quickly quashed as it became evident that there was a desire for both: easily obtainable quantitative badges, rewarding attendance and participation type activities; and, more qualitative badges requiring sustained effort and even assessment to achieve. Rather than a levelling-up structure being off-putting, they saw it as a means to gauge personal growth and evidence a developmental journey for potential employers.

The role of employers will play a major part in the success of any HE open badging initiative. By far the largest driver for students obtaining micro-credentials is to enhance their employability. There is evidence that that employers are starting to look beyond formal qualifications when recruiting, particularly at soft skills. However, there is little in the literature to date which would suggest that open badges feature greatly in their current practices. Indeed, 'few studies address the value of badges as credentials outside of the context in which they are earned' (Spaulding and Johnson, 2016, p. 10). Establishing employer attitudes and intentions with regard to open badges and micro-credentialing is an area that could be usefully explored in future research. As an evolution of the participatory design process, representatives from industry will be included in the next iteration of our open badges development cycle.

While it is still too early to express any firm views regarding the success of using open badges to reward and recognise soft skill acquisition of students in Higher Education, the signs are promising. Students, employers and issuing institutions are tentatively enthusiastic, while barriers to implementing open badge eco-systems are relatively low. Key to their sustainability will be demonstrating a clear link between the attainment of digital open badges relating to soft skills and their impact on employability.

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# Social Networking in a Virtual Learning Environment: Analysis of Social Interactions

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**Abstract**: This article presents the analysis of social interactions of students in a virtual learning environment. The aim is to propose educational activities in distance education that can contribute to social interaction. Authors like Tomaél & Marteletto (2013), Barabási (2009) and Recuero (2009) recognize the importance of social relationships and interactions of the students to the construction of knowledge. Social changes impact the network structures that form from this socialization, both in person and virtual. The methodology was qualitative and quantitative case study type. For data collection were used the tools and Contacts Forum ROODA virtual learning environment. To complete the data collected was used the graphs generated by the Social Map tool. The Social Map shows social interactions carried out in the environment ROODA communication tools. The study included 40 students in a course held in the distance. This course is offered by the Federal University of Rio Grande do Sul in the first half of 2015. The results show that the performance of collaborative activities favors the participation of the most effective mode of students in the class, establishing more cohesive social networks. The social network analysis of the three points that the students could interact more fluently along activities, because of the increase of interactions along the course. It was observed that the last task of the classes the distance obtained a cohesive and participatory group. Therefore, from the analysis of social networks can offer educational activities for teachers, such as plan and carry out collaborative activities since the beginning of the course and motivate students in the use of the virtual learning environment features for social interactions and exchanges.

**Keywords**: social interactions, group formation, virtual learning environment

## 1. Introduction

Education not only provides a relationship with knowledge, but also has a socializing function, to make the subject ready to live in society (Zimmerman, Osorio 1997). In other words, to live in group. In educational terms it is important for students to interact and also build knowledge through the exchange of experiences with their peers.

Both in traditional classrooms and distance learning, the use of virtual learning environments (VLE) has grown concomitantly with the increased availability of courses. Thus, there is a need to adjust and provide tools that enable a consistent pedagogical creation in this area.

The study of social relationships and interactions between individuals is also studied in Information Science. "Social network analysis is part of this field of study and is the methodology that has the analytic capabilities to discover and map the links between individuals and various entities" (Tomaél e Marteletto 2013 p. 246).

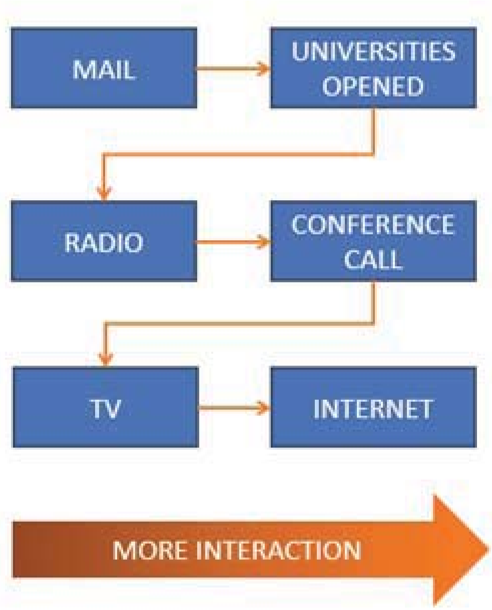
This study focuses on issues related to networking through existing social relationships among members in an extension course developed at the Federal University of Rio Grande do Sul (UFRGS) in order to propose pedagogical activities to motivate interactions. It is primarily motivated by the need to solve concrete and common problems in the daily lives of many educators, especially in distance learning regarding the formation of groups. Thus, in the next section of this article presents some studies on interactions in Distance Learning (DL). Section 3 presents concepts for building virtual social networks. Section 4 presents the methodology used, while section 5 shows the results by mapping the social interactions in VLE. Finally, Section 6 offers final considerations.

## 2. Interactions in distance learning

Interactions in education are critical to students' learning. According to Tardif (2010 p. 166), the interaction begins with the reciprocal interplay between individuals, and "we can schematically define the concept of interaction by saying that it refers to all forms of activity in which human beings act in relation to each other."

Therefore, in-depth studies of social interactions in distance education are now presented. Maia & Mattar (2007 p.6) approach the concept of distance education as "a type of education in which teachers and students are separated, planned by institutions, and use various communication technologies".

Appropriating the technologies applicable to each time period (Figure 1), interactions have followed the transformations through the generations of Distance Learning.




Source: adapted from Rigo (2010, p.30)

**Figure 1:** Generations of distance learning and interactions

Figure 1 depicts some of the evolution in the interactions according to the history of Distance Learning. Andrade and Vicari (2011 p. 259) argue:

> *The interaction is in fact inserted into the mediation process that occurs through instruments and signs. [...] Where are these signs and instruments in distance learning environments? Both can be modeled in chat tools, the language adopted for communication, [...] in the e-mail service, forums, video and teleconferencing, in any and all tools that performs a mediation function.*

Social interaction, which is essential to the collective, takes place through reciprocal actions between individuals that make up a unit, always considering certain purposes. Thus, it is important to note that what is central is the relationship between people, because the interaction is an "action among" individuals who are involved in this action (Primo 1997, 1998). For the author Longhi (2011, p.6) "In the virtual context, the centrality is the student, the interaction is fostered by synchronous / asynchronous communication capabilities".

To clarify, Primo (2005) presents the following classification:

- Reactive Interaction: Developed within the limits of the initial conditions of a system, is subject to predictability and automation in exchanges. Example: Deciding to be friends with someone on Facebook, or exchanging links with someone in a photolog, etc.
- Mutual Interaction: Every action has a recurring impact on the relationship and on the conduct of those interacting. It is a way of being, which modernizes through the actions of a subject in relation to the other(s). That is, the interaction is not simply a sum of individual actions, but those in groups. Example: Talking with someone via WhatsApp or exchanging messages on Facebook, etc.

Thus, it appears that the two classifications are not separate, both can occur simultaneously in a specific virtual spaces (Longhi 2014). According to Ribeiro et al. (2007) the use of VLE provides some advantages:

- Concomitant interaction between the computer and the student;
- The ability to offer individual attention to the student;
- The availability of the student determines their own learning pace, especially in terms of sequence and time;
- Exposure to study materials in a creative, attractive, and integrated manner, which stimulates and motivates learning;
- Likely to be used to evaluate the student.

Given these assumptions, the next section presents some concepts in social networking and virtual construction in order to clarify the interactions in the ROODA environment, the experimental VLE.

## 3. Social networks: virtual construction

According to Martino (2014, p. 55), Social Networks are understood as the "relationship between human beings guided by the flexibility of their structure and the dynamics among participants." In technical terms, "the network (or graph) is formed by a finite set of nodes that represent the actors (individuals, groups or organizations) and edges (or arcs) indicating the connections between them" (Longhi et al., 2014, p.380). These authors point out that even "when reading a graph, the main focus of analysis is on the pattern of connections, the distance and physical position of nodes".

Barabási (2009) argues that everything is connected to everything else, cyberspace demonstrates the fundamental beginning of the freedom of expression. Thus, Recuero (2009 p.24) defines a social network as "a metaphor to observe the patterns of connection established between various actors," namely: people, institutions or groups represented by the nodes of the network, while interactions or social ties are understood as connections. The author also points out that the study of social networks on the Internet, shows how social structures, types, and composition emerged in the face of communication mediated by the computer. These interactions that occur through the virtual environment generate information flows and social exchanges that affect these structures.

As Marteleto (2001) points out, in order to understand the influence of individual characteristics, one should not consider attributes such as class, gender, and age, but instead the number of relationships that are created by individuals through their interactions with each other. The author also confirms that,

> *The goal is to demonstrate that the analysis of a dyad (interaction between two people) has meaning only in relation to all other dyads in the network because its structural position necessarily has an effect on its form, content and function. Therefore, the function of a relationship depends on the structural position of the links, and the same is true regarding the status and role of an actor (Marteleto 2001 p. 72)*

The relational character of social networks, which consists of relationships between individuals, stands out. Martino (2014 p. 57) explains that, "this is not a relationship only between individuals, but a relationship between relations, i.e. a mutual and reciprocal perspective on how people interact". Thus, the important aspect in relationships is the intensity with which the interactions are established and are affected by each other.

Another key element in network analysis is the social bond, which is described by Martino (2014 p.68) as "the reason why a person makes contact with the other - working ties, affective ties, proximity, and so on." To better understand the influence of ties on a social network, it is necessary to understand the strength of the bonds, which can be done through a model proposed by Granovetter (1973). It is based on three factors: 1) How much time is spent with a person; 2) The degree of emotional intensity involved with this individual; and 3) The proximity and/or intimacy, mutual trust, and reciprocity. The more intense these factors, the stronger the existence of the tie, which identifies the strength of a relationship (Martino 2014).

Granovetter (1973) separates the bonds into three categories:

- Strong: Bonds generally of friends and family.
- Weak: Bonds that do not have a direct link, their strength is associated with the number of acquaintances.

- Absent: non existent.

Martino (2014 p.69) argues that the strength of weak bonds are related to the distance between the nodes of a network, because they can be compared with others who are outside the circle of friends and relatives (strong bonds). It then creates the opportunity to connect socially distant subjects. The author also confirms that "weak ties gain strength in that they can become *bridges* between socially distant people." In the study of networks, a person's number of contacts determines the notion of distance between them and the other, thus characterizing an intermediate contact. "Each intermediary is considered a degree of separation." To create new contacts, weak bonds are classified as essential, because the number of acquaintances is generally greater than the number of friends. "However, from these less direct links you can find more distant people and, therefore, cover a larger area of relationships" (Martino 2014 p.70).

As stated by Lazega (2014 p. 30) "[...] a study of networks therefore requires a great deal of clarity regarding the distinction between the different levels of analysis in which one seeks to be situated." Accordingly, the author defines three levels:

- Individual: At this level, the characteristics derived from the relational structure is the element of routine procedures. Centrality and prestige measures are individual and allow individuals to be compared, especially when attributes are added such as education level, gender, social class, etc.
- Relational: The target at this level are the attributes of dyads, triads and/or intermediate substructures. It aims to characterize the relationships themselves.
- Structural: This level seeks to sketch entire social group, by comparing social behaviors. Example: Working groups, organizations, communities, and others.

Thus, the authors confirm that, "the researcher needs to know the relationships between all members of the interdependence system for it to derive such structural measures" (Lazega 2014 p.32).

These definitions confirm the importance of the measure of centrality in networks, because it can identify how we are "in the middle" of the network, or establish "shortcuts" between the distances among the members. Mainly because centrality has the ability to contribute to the perception of the popularity of the node regarding the degree of connection, or the number of connections of a particular node (Recuero 2009).

The author emphasizes that the centrality of the degree of proximity (closeness), refers to the length between the nodes, or the sum of the geodesic[1] distances among all of the nodes of the graph. A high degree of closeness indicates that there is a greater connection and therefore it is more central in the network in relation to others. Moreover, the degree of intermediation (betweeness), which has the function of "indicating how essential a node is for certain information circulating in the network (the higher the degree, the greater its centrality)" (Recuero 2009 p .74).

In this work, network analysis makes it possible to verify, through the patterns of connection, the strength of the bonds, the degree of centrality, proximity, and mediation between the subjects involved.

## 4. Methodology

The study aimed to present social networks formed from the interactions of the subjects in a VLE through graphs. The data makes it possible to indicate educational activities that can be used in order to assist teachers in their classes to achieve greater interaction and cohesion among their students.

The research is characterized as theory-practice because it proposes the (re)construction of ideas and the improvement of theoretical foundations, especially those related to interaction and social networks studies. Thus, to achieve the proposed objective, the study was conducted in four stages: 1) Construction of the theoretical framework regarding the themes covered, Social Interactions in Distance Education and Social Networks; 2) Mapping of interactions through an Extension Course offered by the Federal University of Rio Grande do Sul (UFRGS), Brazil; 3) Analysis of the mapping based on the theoretical framework and the results obtained through the Social Mapping tool; 4) Proposal of pedagogical actions.
Thus, the research is characterized as qualitative and quantitative with a descriptive approach, using a case study. The observation and data collection were performed using an extension course offered by the Federal

[1]The geodesic distance is the least possible between two nodes.

University of Rio Grande do Sul (UFRGS) in the first semester of 2015. This class initially had 40 students. They were between the ages of 17 and 50 years old and were 66% female. There were 39 students at the end of the course. Only one student did not participate until the end of the course ultimately abandoned. The virtual learning environment used in this study was ROODA (http://ead.ufrgs.br/rooda). The number of students throughout the course was the same (39 participants), which changed the course of the activities was the composition of the groups. There were collaborative case analysis activities and the construction of solutions that were designed to use two features: The Forum and the Contacts for social exchanges. The Social Map feature is shown in the form of graphic mapping of the interactions.

## 5. Results

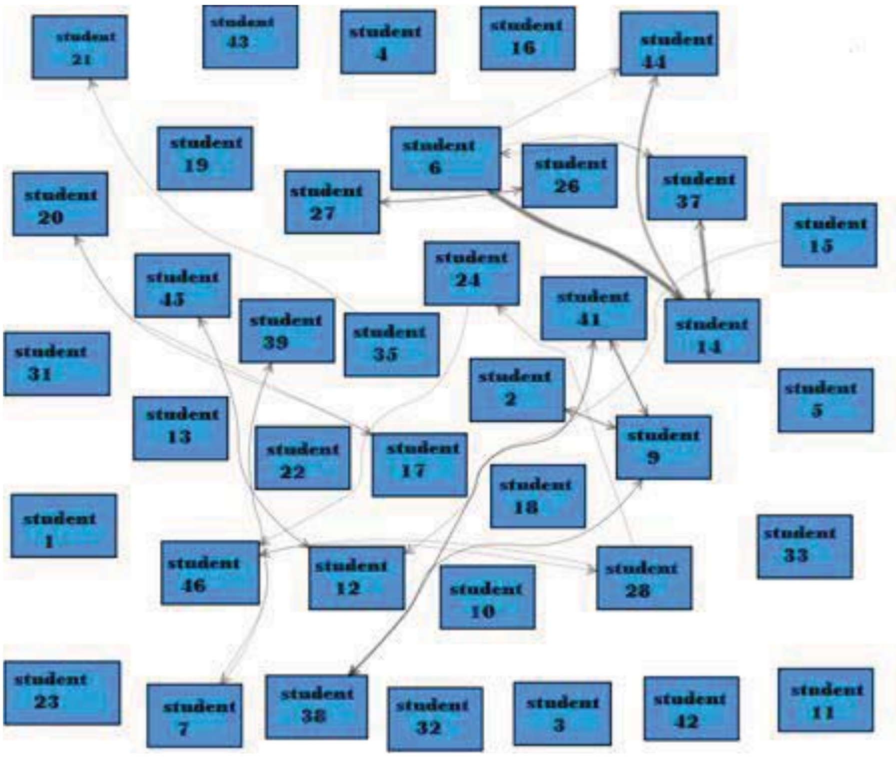
Social Map is a feature that enables the construction of graphs to check the relations established in the VLE based on the users' interactions with the communication tools in ROODA.

In a network composed of subjects of different values, some actors perform the role of a bridge for some time, ensuring that information circulates throughout the network. From the Social Map it is possible to identify links, influences, and preferences that exist in a class. This feature is available only to the teacher of that class.

In this course, three collaborative case analysis activities were requested and suggestions for improvement were suggested. During the course the same types of activities have been applied. This proposal was made to maintain a standard and not interferer the goal of course was to map social interactions. Students could use the Forum and Contacts features in VLE ROODA for exchanges and interactions. Thus, the mapping in this work is presented in three different periods of the class, based on the three collaborative activities requested.

It should be noted that the connections between one node and another (VLE participants) vary according to the number of interactions performed. For example, the line will be wider in a case of a high number of interactions. This reveals to the teacher that students had more interaction during the selected period.

Figure 2 shows the mapping of the first week of the initial activity, which refers to the period: 05/21/2015 to 05/28/2015. This first social map shows the relationships of all students in the course (40 participants). Only this map appears the total number enrolled in the course that was 40 students.

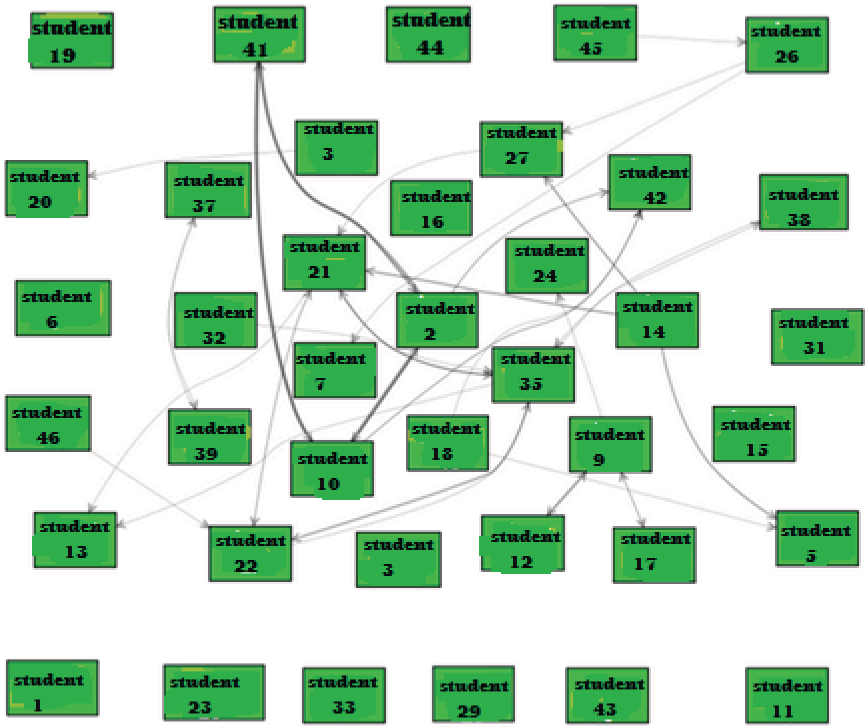



Source: Adapted from VLE ROODA (2015)

**Figure 2:** Mapping of the first week of the initial activity

The Social Map (Figure 2) demonstrates that the interaction between the participants is still quite minimal, which may be explained due to the fact that this was the first activity. One can see that the strongest bond in this network is between students 6 and 14, followed by a lower intensity bond between students 44 and 14, as well as students 14 and 37. The rest show weak bonds, they show a weak connection through thin lines. The most popular student is number 6, which has the highest number of connections.

Figure 3 presents the mapping of the first week of the second interactive activity, which refers to the period: 06/04/2015 to 06/11/2015.




Source: Adapted from VLE ROODA (2015)

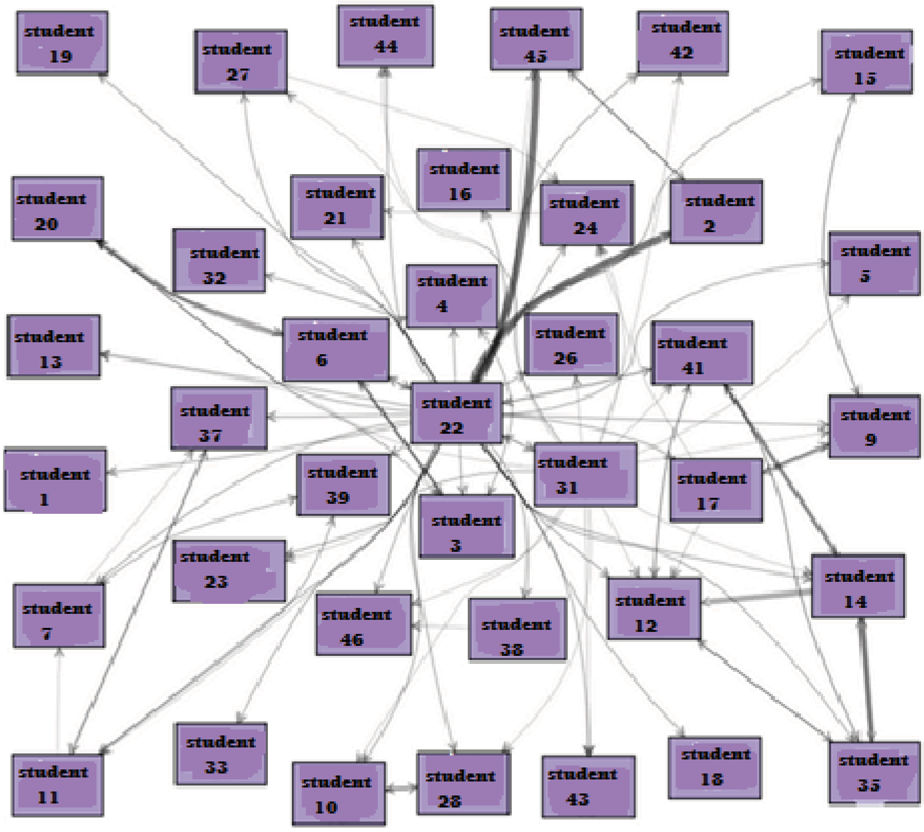
**Figure 3:** Mapping of the first week of the second interactive activity

This map has been not included the student who dropped out of the course, with a total number of 39 students. This map shows strong bonds between nodes: 41 and 2, 41 and 10, and 10 and 2. Yet, the other bonds are of lesser intensity and can be characterized as weak. Student 21 stands out as the most central, the most popular, with five connections. Students 2 and 10 can be classified as closeness due to their proximity and centrality in the network. In this activity, students began to interact more than at the beginning of the requested task. Yet, some members still waited for their colleagues to act.

Figure 4 is the mapping of the first week of the third interactive activity, which took place during the period: 06/18/2015 to 25/06/2015.

The social relations in the third and final interactive activity show that the connections are more intense, with a more evident degree of affinity. Strong bonds can be seen in the interactions of students 22 and 45, and 22 and 2, followed by slightly less intensity by students 14 and 35, 14 and 12, and 20 and 6. The remaining students can be considered to have weak bonds. Student 22 is highlighted as the most popular, characterized by their centrality and possible influence on the network. Nodes showing closeness were: 22 and 6, 22 and 26, 22 and 31, 22 and 39, 22 and 3, 22 and 4, which showed a high degree of proximity and centrality.

The requested activities were proposed as the use of communication tools that would enable training and development groups. In the central theme proposed activities was related to the area of management, addressing the four administrative functions: planning, organizing, directing and controlling. Students should carry out case studies and build solutions in all activities.




Source: Adapted from VLE ROODA (2015)

**Figure 4:** Mapping of the first week of the third interactive activity

The standard proposed in the activities enabled a greater focus on social interactions, maximizing the relationships established by students. This type of pedagogical strategy allows for greater analysis of the communication tools. The Forum tool is effective to establish a stronger link between the students and foster discussions on activities. The virtual diary tool was not effective because it was not relevant to the students as well as the chat tool. The chat tool is not effective because it was replaced by ordinary tools such as the WhatsApp etc. The activities and teaching strategies used allowed an analysis of the implementation or remodeling resources in the environment that can bring more students in order to allow greater social interaction.

Thus, after analyzing the three networks, it appears that the class could interact more fluently through the course of the activities, as evidenced by the increase in interactions between members throughout the course. The choice of the analyzed periods was intended to demonstrate how students organized themselves based on the request of collaborative challenges. It therefore appears that a cohesive and participatory group was achieved in the final task.

Students in all three activities are always the same. However, in some activities not all students interacted with more intensity. Therefore, it is observed that in different contexts the students communicate differently.

From the analysis above, we propose pedagogical actions to educators, such as: 1) Planning and conducting collaborative activities from the beginning of the course; 2) Motivating students to use of VLE features for social interactions and exchanges; 3) Encouraging students to participate more actively and use the VLE more frequently; 4) Encouraging the formation of groups to carry out the activities; 5) Using resources that can map and diagnose the social interactions of students.

Below are the final considerations regarding the analysis of this study.

## 6. Final considerations

Several authors such as Tomaél & Marteletto (2013), Barabási (2009), and Recuero (2009) recognize the importance of social relationships and interactions of the students to perform well in the activities developed in the educational context. Social changes impact the network structures that form based on this socialization, both in traditional and virtual classrooms. In agreement with these authors, it is believed that the understanding of interpersonal relationships among students, their structure, and the position that individuals occupy in it, allow the educator to create or reformulate pedagogical strategies to solve problems linked to social interactions.

Actions proposed include the need for the teacher to be more incisive in the beginning of the activities, with more interactive proposals that contribute to building social bonds from the very first weeks of class. This facilitates the construction of a more cohesive and participatory group.

It is noteworthy that beyond visually presenting how the network is established, the Social Map tool serves as a support to diagnose interpersonal relationships in a VLE.

Based on this analysis, it is possible for the teacher to create pedagogical strategies that can assist in social exchanges and leading activities carried out with students, especially in distance learning.

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# Knowledge Generation in Technology-Enhanced Health Exhibitions: Using Eye-Tracking Methods to Understand Audience Knowledge Generation in Health Promotion Exhibitions

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**Abstract:** This paper presents results from eye-tracking studies of audience interaction and knowledge generation in the technology-enhanced health promotion exhibition PULSE at a science centre in Copenhagen, Denmark. The main purpose of the study was to understand what types of knowledge audiences build in health promotion exhibitions designed to include direct physical interaction. The current study is part of the larger PULSE project, which aims to develop innovative health promotion activities that include a science museum exhibition as a key setting. The primary target group is families with children age 6–12. Health promotion technologies are defined here, as technologies designed specifically for the purpose of health promotion, be they educational or focused on physical activities. The study was conducted in late 2015 and comprised eight families with children in 2nd-6th grade visiting the science centre. Eye-tracking glasses and qualitative interviews were used to collect data. Before entering the PULSE exhibition, one adult in each family group and one child in each school group were asked to wear eye-tracking equipment while interacting with various installations. Primarily adult test persons were chosen because wearing the eye-tracking glasses seemed less of an intrusion for adult visitors than for children. The glasses recorded audio, video and gaze point from the test person's point of view. All members of each group were interviewed briefly following their interaction with the exhibition to understand how they had experienced the exhibition, what they saw as the thematic focus and if they thought they had gained new knowledge from the activities. Results from the project indicated that the participants gained knowledge linked to both health fitness topics and social aspects. Results also showed that the exhibition supported both themes related to discovering new types of physical activity and themes of collaboration and social family activity.

**Keywords:** health exhibition, eye tracking, science museum, visitor studies

## 1. Introduction

In this paper the central focus is to understand how science centres can potentially play a role in promoting audience knowledge and action competence for managing or changing wellbeing and health condition. In recent years non-communicable diseases (NCDs) have gained increasing attention in the international public health community based on evidence of overtaking infectious diseases as the main cause of death (WHO, 2005). The reasons for this increase in e.g. type 2 diabetes and related diseases are extremely complex and beyond the scope of this application. Some of the essential risk factors, however, are unhealthy eating practices and physical inactivity that lead to obesity. Among young people living in Europe the increasing prevalence of obesity is clear and the patterns of food intake and movement are well described (WHO Europe, 2008; WHO, 2009) – though large differences exist between various countries.

Information and communication technologies are generally viewed as new and promising tools for innovative reformation of health care systems (WHO, 2005). Information technology in health care receives extensive attention but less focus is placed on their use in health promotion. Several categories exist for what we define as health promotion technologies – technologies designed with the aim of supporting health promotion (Magnussen & Aagaard-Hansen, 2012): *exercise instructing technologies* specifically designed to instruct or facilitate specific forms of physical exercise such as dance and sports games; *didactic health promotion technologies* designed specifically for formal educational purposes such as web- or game-based educational portals where students solve quests related to health issues; *self-monitoring technologies* designed for monitoring of physical activity such as pedometers; and *network health promotion technologies* designed for facilitating social networking in relation to health promotion initiatives such as sports activities or patient wellness.

Play and learning technologies can potentially provide new tools for health promotion in informal learning environments offering new settings and types of participant control over health activities especially for young participant groups. It is therefore central to understand what new learning perspectives these technologies offer in informal learning settings such as science centres. The current paper is based on studies of audience interaction with the health promotion exhibition PULSE at the Danish Experimentarium Science Centre, where health promotion technologies are closely integrated in all exhibition installations. Studying audience interaction in this setting leads to exploring the influence of health promotion technologies on knowledge generation. In this paper we thus explore what types of knowledge the audience expressed having gained after visiting the PULSE exhibition and how the exhibit design influenced this.

## 2. Background health exhibitions and tracking informal learning

This study focused on understanding potential learning perspectives in the science centre exhibitions context integrating health promotion technologies. In this context it is central to understand both the central aspects of learning in a museum context and competence development in relation to the broad and positive health promotion concept.

There are numerous studies on family learning in museum and science centre settings. Studies documenting parents and children communicating at science museums demonstrate how such spaces can introduce children to science as an academic discipline (Crowley & Jacobs, 2002). They also document how children build scientific expertise and other academic knowledge by visiting science museums and talking to their parents during and after their visit. Studies further indicate that families often have a social agenda and expect to have a positive social experience when visiting a science museum. Many parents consider the visit successful if their children acquire deeper insight into science and technology by playing games and engaging in a variety of activities (Falk & Dierking, 1992). The experience can be even more positive when parents feel that they also gained new knowledge. Parents are the key to creating social interaction in the family involving exhibition activities (Briseño-Garzon et al., 2007). Overall research results from various fields indicate that science museums have the potential to act as a learning setting where families develop knowledge on science and health issues by participating in health promotion activities.

Participation is a core element of democratic health promotion (Jensen, 2009). To create permanent change in behaviour actively involving the target group is necessary to create action competence along with a sense of personal ownership regarding change. Participation is closely linked to the notion of empowerment (Freire, 1972). A broad and positive concept of health includes wellbeing and quality of life, as well as the absence of disease (WHO, 1947). This concept acknowledges that health is influenced by behaviour and lifestyle as well as living conditions, which are often not addressed in health campaigns (Jensen, 2009). Health promotion research points to the importance of involving multiple settings and stakeholders in target group communities to promote sustainable health changes (Algazy et al., 2010). Settings are often defined by a combination of physical boundaries and/or organisational features.

Building competence for taking action and participating in changing health and wellbeing is central to modern health education (Jensen, 2000). Bruun Jensen argued that the concept of action competence is central for understanding how target groups take action to change their health and wellbeing. Action is here defined by something that “involves inner decision making” and external goals and “is deeper” than behavioural change. Actions involve conscious decision-making that, according to Bruun Jensen 2000, p.148, is different from the concept behavioural change:

> *Expressed briefly, an action as defined by the democratic paradigm has two key characteristics: it should be purposefully directed at solving a problem or facilitating change, and it should be consciously decided on by those carrying out the action. In other words, an action is targeted at change, which may be a change in one's own life-style, in the school, in the local society or in the global society, and an action is intentional.*

Bruun Jensen defined four dimensions of knowledge central for target groups’ building competence promotes action to change health and wellbeing (Figure 1): 1) Knowledge about *effects*, this is knowledge about ‘what’ effect is caused by the surrounding environment or a specific behaviour; 2) Knowledge about *causes*, knowledge about 'why' we have the health condition we have and what factors affect our health; 3) Knowledge about *strategies*, knowledge about 'how' we change a health condition and 4) Knowledge about alternatives and *visions*, knowledge about 'where' we can go to fulfil visions for the future life conditions (Jensen, 2000; 2009).

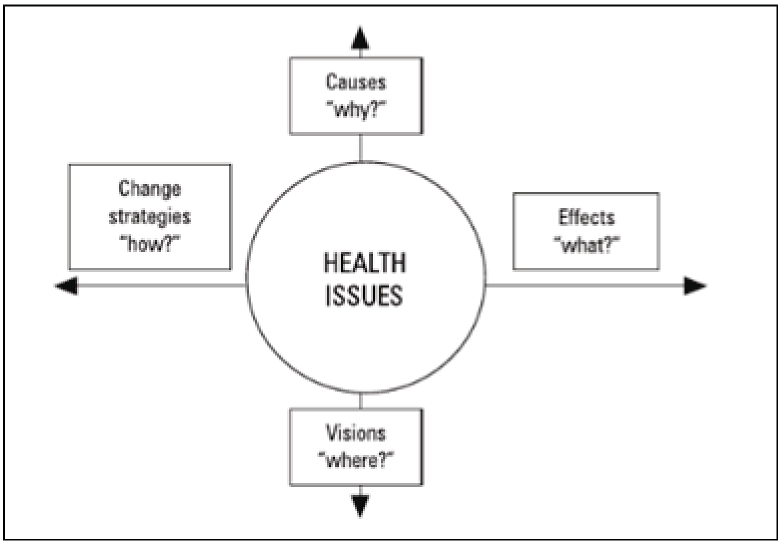


**Figure 1:** Four dimensions of health-related knowledge central to building action competence (Jensen, 2000)

The studies in the current paper are focused on understanding the types of knowledge the audience gained from visiting the health promotion PULSE exhibition. The target group for the exhibition was families with children aged 6-12 years old. The PULSE exhibition had gone through iterations of research-based development with focus on building principles of the broad and positive health concept into the exhibition. The aim was to utilise the science centre as an informal learning space for supporting knowledge generation related to building action competencies. This is further described below.

## 3. The PULSE exhibition and data collection methods

The studies resulting from the current paper are part of the larger PULSE project running from January 2013 to December 2016. PULSE project's vision is to create innovative science exhibitions and activities in local settings in Copenhagen to motivate and supports families taking steps to develop and maintain a healthy lifestyle. PULSE project focuses on research and development in several settings. There have thus been development and research activities both at the science centre exhibition and in other local and digital settings. The current paper presents the results from studies in the Experimentarium exhibition space with focus on understanding what knowledge families and school classes with children aged 6-12 perceived to gain from interacting with the PULSE exhibition and how this was influenced by different installations.

The exhibition went through several iterations of research-based development, intervention analysis and redesign. The methodology used in the development of health promotion components of PULSE followed a design-based research (DBR) process and involved various cycles, interventions, analyses and redesign (Brown, 1992). In design-based research the focus is on developing learning environments along with domain specific theories (Cobb et al., 2003). The method serves as a framework for integrating differing approaches at the various stages of research and development (Squire, 2005). Theoretically the PULSE development process presented a broad and positive concept of health including wellbeing and quality of life (WHO, 1947) along with theories of democratic health promotion (Jensen, 2009), ownership, participation and empowerment (Freire, 1972). In the first phase, representatives from the primary target group – the so-called PULSE families – were invited to participate in the co-design of the first exhibition concept with developers and researchers in the project (Sandholdt & Ulriksen, 2016). The exhibition prototypes were developed based on co-design results and PULSE families' interventions. The theme of the exhibition is a slightly twisted version of a home setting. Each family receives radio-frequency identification armbands at the entrance to the science centre and logs in as a family group to interact with the PULSE exhibition installations. This strengthens the family experience central to the target group. Installations include a gamified kitchen where families gain points for climbing on the walls and furniture and loose points for touching the floor. Other installations include a bathroom where participants dance with a virtual cleaning lady, a hallway where participants climb as fast as possible under strings and over messes left on the floor and a living room where participants try to knock team members of a rodeo-like easy chair, pulling on attached ropes. In the second DBR iteration the authors of this paper studied how the audience perceived knowledge gain from the PULSE exhibition with focus on understanding knowledge generation in health promotion exhibitions to explore potential re-designs in the exhibition that will strengthen audience learning.

### 3.1 Data collection and categorisation methods

The study of perceived audience knowledge generation was conducted with eye-tracking methods supplemented by interviews. Studies were primarily done on weekend days where visitors at the Experimentarium were primarily families and also during weekdays where the audience primarily consisted of school classes and their teachers. The study was conducted with 8 family groups and 2 school groups of 2-5 members. The respondents were chosen from the visiting audience based on their match to the target group of the project; families with children age 6-12 years old. The groups were invited to participate in the eye-tracking study before their first visit to the exhibition. After the eye-tracking interaction in the PULSE exhibition group members participated in short un-structured group interviews (Kvale, 1996) with questions about the perceived theme of the exhibition and the perceived knowledge gain from interacting with the installations. Interview data was categorised in a grounded theory process (Strauss & Corbin, 1990) and two main themes were generated. The themes will be described in the findings section along with results of eye-tracking findings.

#### *3.1.1 Eye-tracking methods*

In the eye-tracking study one adult in each family group and one child in each school group was invited to wear eye-tracking equipment. The use of eye tracking in this context relies on the idea that human physiological capacity to obtain, or sample, visual information from the surrounding environment is inherently limited by the structure of human eyes, which can only receive high acuity visual information from a very narrow visual angle at any given point (Land, 2014). Perceptual processing capacity is also inherently limited, and consequently, there is a high correspondence between the locus of overt attention and the direction of the gaze. Thus, by tracking where a person is looking on a moment-to-moment basis provides rich information about what information is being sampled and used in visually guiding the activities people are engaged in, and in situated learning and social communication processes (Lauwereyns, 2012). In this study, we implemented eye tracking using a mobile glasses eye tracker (SMI ETG 2w 60hz, SensoMotoric Instruments GMBH, Teltow, Germany). Mobile eye tracking uses non-invasive recording technology that relies on illuminating the eye with a safe-intensity infrared lamps and tracking the position of thei reflections in the moving eye using an infrared camera. SMI ETG 2w system is built into sports glasses (about the size and weight of skiing glasses) and uses a smartphone with custom software to record data. The system is worn by a participant in the same way as sports glasses are worn and the data recorder is worn in a small belt pouch. Thus, this system provides high mobility and allows the participant to move freely and interact with the surroundings in a nearly unrestricted way (apart from the slight limitation of peripheral vision by the frame of the glasses and the limited conscious effort on part of the participant to avoid damaging the equipment). The output data is a gaze overlay video, that is, a 1280x960 pix 24 fps color video recording of the subject's point of view (the camera is positioned approximately between the eyebrows) with the position of the gaze marked by a marker in each frame. Gaze position is estimated by the eye tracker firmware from a 60hz recording of the eye position matched to the position of the gaze within the recorded field of view. Gaze overlay video also contains an audio track recorded via a microphone mounted in the glasses, thus recording what the participant is saying and some surrounding sounds (e.g., what another person standing close says in a conversation). Recordings using eye tracking began with explaining the equipment to the participant, fitting and calibrating the eye tracker, and starting the recording, after which the participant moved freely around the exhibition until they decided to stop their participation (on average, after about 40 minutes, the time needed to go through most attractions in PULS exhibition). Data was qualitatively analysed by reviewing the gaze overlay videos and matching the locus of overt visual attention with the participants' utterances, following procedures described in Holmqvist et al. (2011).

## 4. Findings

The presented study of the PULSE audience experience of knowledge generation is described based on both interview and eye-tracking data from audience activity in the exhibition. However, the study of health promotion knowledge generation in the PULS exhibition was also informed by results from evaluations of the PULSE exhibition. In the evaluation survey 81 visiting families answered questions about their opinion of, and satisfaction with, the experience at Experimentarium. 39 of these families stated they had visited the PULSE exhibition and proceeded to answer questions about their experience and satisfaction specifically about the PULSE exhibition (Zachariassen & Magnussen, 2016). These evaluations were made as part of the larger PULSE project. Survey results from evaluations of audience experience of PULSE as a learning experience revealed that a majority of the families visiting PULSE view the exhibition as “Somewhat” (43%) or “Very much” (34%) whereas only 2.3% answered “Not at all” in learning experience (Figure 2).

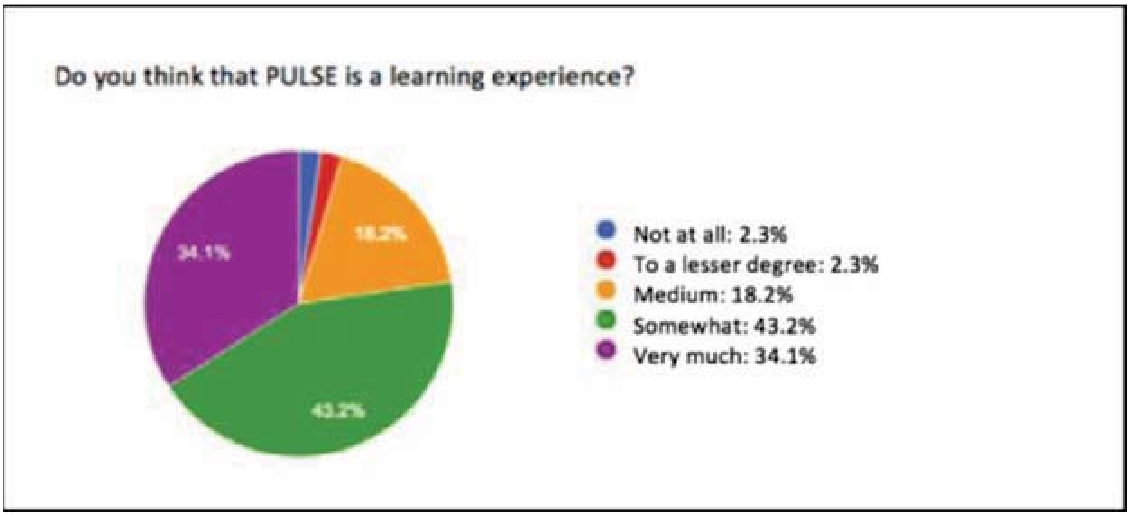


**Figure 2:** Survey results from 39 families after visiting the PULSE exhibition (Zachariassen & Magnussen, 2016)

The evaluation further investigated the audience experience of learning from interacting with the exhibition (Figure 3). In this survey the audience was allowed multiple answers and the majority of the audience “Felt challenged” (97%), “Gained new knowledge about physical activity” (52.9%) and “Was inspired to be more physically active” (44.1%), whereas only 32.4% of the audience answered “Gained new knowledge about health.”

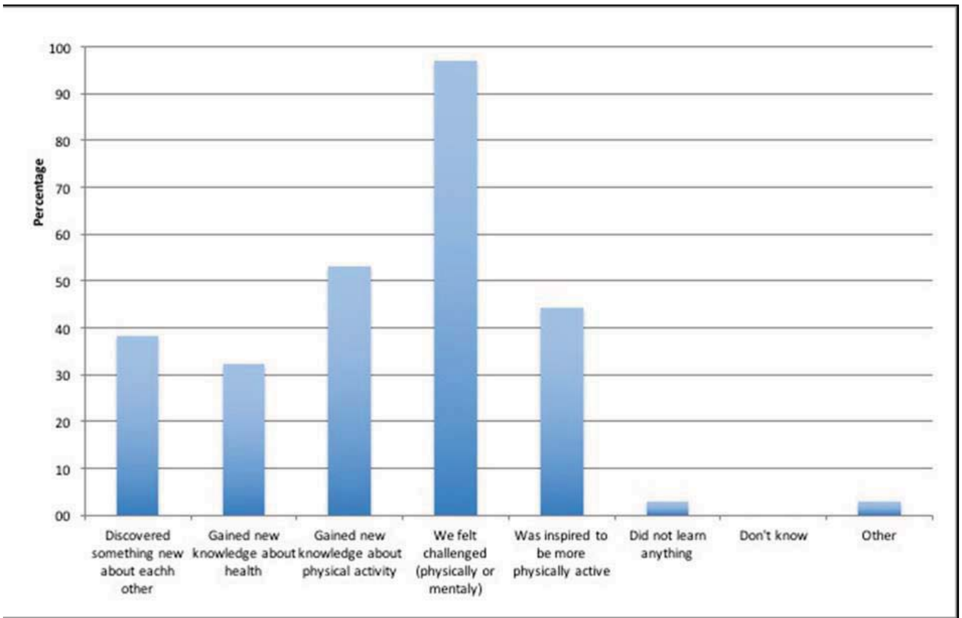


**Figure 3:** Answers from PULSE audience to the question “In what way/how is PULSE a learning experience? Only presented to people who answered positively to the question on whether PULSE is a learning experience. Multiple answers were possible for respondents: Discovered something new about each other/myself 38.2%; Gained new knowledge about health 32.4%; Gained new knowledge about physical activity 52.9%; We felt challenged (physically or mentally) 97.1%; Was inspired to be more physically active 44.1%; Did not learn anything 2.9%; Don’t know 0.0%; Other: 2.9% (Zachariassen & Magnussen, 2016)

This study thus encouraged further investigation of the types of knowledge the audience expressed gaining and what in the exhibit may have influenced this building of different types of knowledge. During the grounded analysis of data from the interviews conducted with eight families and two school groups after their first visit to the PULSE exhibition we identified the following categories:

- Movement / exercise
- Experiencing what one's body can do / Doing something physical you did not believe you could
- Health
- Collaboration
- Family & community

The categories were grouped into two overall themes: 1) Movement and the experience of new types of physical activity and 2) Family, community and collaboration. Next these various themes will be described.

## 4.1 Themes: Movement, experiencing new types of physical activity

After their first visit to the exhibition some of the families said that the theme of the exhibition was movement and exercise. The interview respondents explained how they specifically experienced new knowledge gain about their body and physical potential such as knowledge about "how high you can jump," "how fast you are," knowledge about being unfit, "exercise and your heart rate" and "new knowledge about how to do things", such as jumping higher and dancing. Responses also included answers such as knowledge about "energy consumption" but the majority of the families' responses were related to gaining knowledge about their bodies. This type of knowledge was particularly mentioned in relation to installations such as "the kitchen" where you had to be fast to press light switches, the "jump over fence" installation where the challenge was to jump as high as possible and the Bike Shed, where the challenge was to race family members. An example of the latter was a description by a 6-7-year-old girl in the interview with one of the test families:

> *Interviewer: If everyone had to try to explain what this exhibition is about what do you then think it's about?*
> *Girl: I think it's about technology and what you're like inside your body.*
> *Interviewer: How you are inside your body?*
> *Girl: Yes, you find out what you are like inside.*
> *Interviewer: Can you try to explain it?*
> *Girl: Well, for example, what you can do that you weren't aware of, like that thing with cycling and heart rate for a minute and things like that.*
>
> *(Interview with Family A after first visit to PULSE exhibition)*

In the citation above the girl from Family A referred to an installation in the exhibition where the family cycles together on exercise bikes. Sensors in the bicycle handlebar measure heart rate on four bikes located next to each other. In front of the bike is a large screen where a movie simulates a family bike ride to the beach. Participants receive instructions first to cycle and then to rest to see how fast their heartrate decreases to a resting rate. Information about who takes the lead in the bike ride and the different member's heartrates is also given on the screen. In the eye-tracking studies of Family A focus was on understanding what in this installation influenced building knowledge about "how you are inside yourself" and "what you can do, that you weren't aware of". Family A had three members: a father and two girls 6-7 years old and 9-10 years old. The family first approached the cycle installation while another family was using it. In Figure 4 and the first citation, the father wearing the eye-tracking glasses and Family A are watching another family using the bikes:

> *Dad (with glasses): It looks fun (Bike Shed)*
>
> *(Watches family before them)*
>
> *Dad (with glasses): Should we try this one girls, or should we try something else?*
>
> *Youngest girl: I'd like to!*

*Dad (with glasses): (still watching other family) See it's the pulse, it shows the pulse of how many times your heart beats in a minute. See, his heart beats 167 times a minute.*

*(…)(Family gets on the bikes)*

*Youngest girl: when shall we start?*

*Dad (with glasses): It reads the pulse. See, it reads our pulse*

*Dad (with glasses): Great you're in the lead. Where are the others? It says you have more power. It says give it all you've got! Come on! Yes!*

*[00: 15: 34.08] Dad (with glasses): See it's our pulse.*
*(…) (Interview right after Family A tried the Bike Shed)*

*Youngest girl: I'm sweating!*

*Interviewer: I can see why.*

*Dad: There's nothing intellectual about it. It was very physical.*

*Girl: Try to feel how much I am sweating!*

*Interviewer: (laughs)*

*Dad: Yes, it's wonderful (laughs).*

*(Transcript, eye-tracking studies of Family A testing the Bike Shed installation in the PULSE exhibition).*


**Figure 4:** Screen shot from eye-tracking studies of Family A. The father in Family A (wearing eye-tracking glasses) is watching another family using the Bike Shed while he and his daughters are waiting to try it. The text on the screen says "Bike Shed", shows biking time (0:20) and "Feel your body and see your PULSE fall". The digits represent the different family members' (different colours) heart rate per minute. The boxes also indicate who takes the lead in the virtual bike race

In the above situation the girl and the family received different types of information in testing the installation. Before trying the bikes they first received information about how to use the installation from watching another family. The father however also used one of the family members as an example for explaining what is measured, "his heart beats 167 times per minute." The bike interaction between the father and the girls was focused on his physically challenging the girls and encouraging them to bike faster. This was possibly what the girl referred to later when she expressed that she gained new knowledge about "what you can do, that you weren't aware of." After the activity the girl expressed that she was sweaty referring to what could be called embodied information she also mentioned new knowledge of finding "out how you are inside yourself."

## 4.2 Themes: The family, collaboration and community

Another major theme in the interview with the families was the family experience, collaboration and family community. This included knowledge about "being together as a family," "doing something with the family that you haven't tried before" and "doing something different from at home but in a way the same." This knowledge was specifically mentioned in relation to the installations "the kitchen" and the "ball court," where families collaborate to get as many points as possible by climbing around on the kitchen furniture without touching the floor and switching off light switches and dropping balls in holes on a court. Another mentioned installation was "the bath" where families danced together following a virtual instructor on a screen in a bathroom setting (Figure 5). An example of the latter was a description made by the mother in Family B following their interaction with the installation:

> *Mother Family B: I think it's fine for a family to do something together. I think they were good activities and everybody could participate because with the others over there (points to installations outside the PULSE exhibition), they say "I can't work it out" and then give up, but here it was fun for everybody, I think.*
> *Interviewer: The youngest you mean?*
> *Mother and father: Yes.*

> *Interviewer: What do you think this exhibition is all about?*
> *Mother: It's learning how to exercise in a fun way. Well, I think… so you can exercise in other ways than just running. Here you can also get your heartrate up cleaning the bathroom or anything by doing it together. You don't have to go to the gym. You can do anything together to get exercise and things like that. (Transcript from Interview Family B after first visit to PULSE exhibition)*

As described "The Bath" is a room based on features from exercise dance games where players get scores for copying a virtual character's movements. In the installation the members of the group dance in front of a virtual cleaning lady and gain points for how closely the members' movements reassemble the virtual character's movements or the percentage of "cleaning" that they do. In the eye-tracking studies of Family B focus was on understanding how the mother influenced the mentioned themes of collaboration, community and family. The family consisted of two adults, a mother and father, a younger boy and an older boy. In the below citation and in Figure 5 the father is wearing eye-tracking glasses and the family is getting ready for dancing in the installation in front of the screen with the virtual cleaning lady.

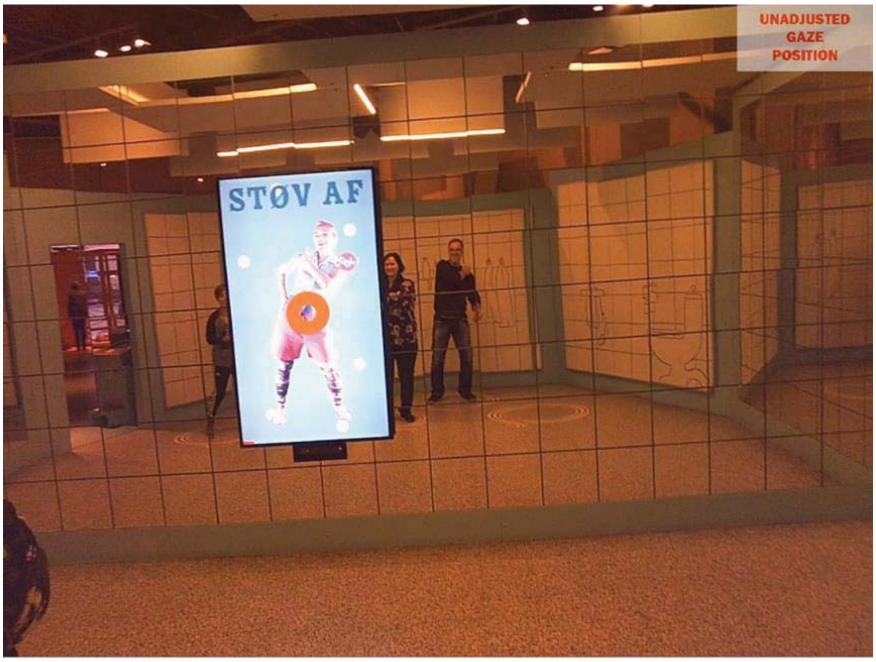


**Figure 5:** Family B dancing in the bathroom installation. The text on the screen: "Dust off" (Støv af)

*Dad (with glasses): Go to a round one (marks on the floor).*

*Bigger boy: Ooh noo!*

*Dad (with glasses): I'll stand over there in the back and hide. What to do? What should we do?*

*Dad (with glasses): Okay, so we have to agree on what … (laughs).*

*Mom: (reads aloud) You're not standing on the marks.*

*Dad (with glasses): (laughs)*

*Mom: (laughs)*

*Mom: (reads aloud) Whoops, some of you aren't dancing (laughs. Looks at dad).*

*Dad (with glasses): What? (laughs)*

*Dad (with glasses): Oh my god (laughs), there sure isn't any rhythm here (laughs).*

*Bigger boy: 77 points!*

*Mom: 77% clean. It was dad (looks back at father, laughs).*

*Dad (with glasses): Was I the one who didn't bother to clean or what? (laughs)*

As in the situation with Family A in the Bike Shed, Family B received information about how to perform the movements and interactions in the installation. The dialog and the citation from the interview with Family B however indicated that the knowledge and information discussed in the interaction in this installation is different from the information in the cycling installation. This is partly due to the way the interaction is valued. The score in the bathroom dance installation is given based on how well the family members do collaboratively. This resulted in discussions on collaboration both in relation to all members standing on the marks for the game to operate and by the father who claimed that the score is low because he did not bother to "clean" or did not dance as well as the other family members. Interacting with the installation participants thus did not receive information about their body or "how you are inside the body" such as heartrate and pulse as expressed by the girl in Family A, instead, the focus was on the social aspects of movement in the group which were also reflected in the dialog on collaboration for success. This is also expressed in the interview with the family where the mother pointed out that they gained knowledge about doing physical activities together.

## 5. Discussion and conclusions: Finding various types of knowledge

The two main themes presented here, "Experiencing new types of movement" and "Family, community and collaboration" clearly depict how the various families experience the theme of the health promotion exhibition PULSE differently and how the assorted installations and actions facilitated by the embedded health promotion technologies influence their experience. The main focus of this study was to understand the types of knowledge the audience felt they gained from interacting with a health promotion exhibition like PULSE. We applied the perspective of the four dimensions of health-related knowledge central to building action competences (Jensen, 2000, 2009) in order to analyse our findings and came to the conclusion that not all these dimensions are represented in the PULSE exhibition.

With regard to the bike installation, the girl interviewed in Family A said that provided her with knowledge about "what you are like inside" and "what you can do that you weren't aware of". In the dialog with the father, he encourages her to do better in the bike race and she talks about how the cycling has an effect on her body, for instance by making her sweat. This experience is covered by the first dimension, which concerns knowledge about effects, in this case the bodily effects the surrounding environment causes that the respondents in Family A mention. An analysis of how the bike installation supports this understanding shows that the interaction between the bike, the screen and the people biking is focused on providing the audience with technical data about their heart rate challenging them to race against each other. This represents a self-monitoring technology that provides feedback on the individual performance compared to other competitors (Magnussen & Aagaard-Hansen, 2012).

Contrary to Family A, Family B primarily experiences the PULSE exhibition as a social event where the family can learn new types of exercises to do together. The mother talks about how the exhibition activities taught them about how to do alternative physical activities compared to what they usually do. This experience falls into the fourth dimension of health-related knowledge, i.e. knowledge about alternatives and visions. The family's interaction with the bathroom installation required collaboration to gain a reward and, in contrast to the bike installation, participants received information on how well they performed the activity together and not individual feedback on bodily responses. The bathroom installation with dancing is an example of an exercise instructing technology specifically designed to teach or facilitate specific forms of physical exercise (Magnussen & Aagaard-Hansen, 2012).

When the test families were interviewed only the two overall themes discussed here were apparent, which indicates that future studies must consider if and how it would be possible to create a design that incorporates the two remaining knowledge dimensions: knowledge about causes, knowledge about 'why' we have the health condition we have and what factors affect our health; and knowledge about strategies, knowledge about 'how' we change a health condition (Bruun Jensen, 2000; 2005). Two examples of possible health promotion technologies that can be used are didactic health promotion technologies, which are designed for formal education in health issues, and network health promotion technologies, whose design facilitates social networking in relation to health promotion initiatives. These two technologies can potentially provide platforms for reflection and action in relation to the causes of health issues and strategies for improving wellbeing.

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# Fieldwork: Is it a Competitive or Complementary Tool in e-Learning for Tourism?

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**Abstract**: Market competition through quality in tourism is a challenge for the educational sector. Considering a role of customer-perceived quality and tourists' satisfaction for generating profits in the future, organisations have adopted quality strategies in providing their services. As a consequence, quality management becomes a crucial subject of study for students of tourism. A national perspective on educating for tourism is too narrow for a global tourism market. Cross-cultural aspects of service in tourism require cross-cultural understanding of the teaching philosophy. The service expectations of tourists depend on their national/cultural background. Also service deliverers (e.g. tour operators) have different concepts of service quality depending on their national and cultural environment. The process of education for tourism requires students to be able to understand this cross-cultural context by learning based on an experiment and their own experience. This creates a need for a specific pedagogical approach in many aspects of programme content and methods of its realisation. Fieldwork with students and professors from different countries combined with e-learning would be an innovative methodological approach to improvement of service for tourists. E-learning could be implemented as a complementary method in education as it can stimulate process innovations in education. The purpose of this study is to conceptualize fieldwork as problem-based action-learning and formulate its objective; an evaluation of the educational process based on fieldwork will be identified as a starting point for future improvements in tourism education. Methods applied in this study include: a qualitative approach using critical analysis of literature, observation of teaching programmes for tourism in Poland and benchmarking leading to development of educational effects. Expected results: added value of a complementary use of e-learning and fieldwork in education for the tourism sector will be identified, and educational intangible effects will be described.

**Keywords**: problem-based learning, tourism education, complementary e-learning

## 1. Introduction

Field research or fieldwork can be understood as collection of information outside a workplace setting, a library or a university. The approaches applied in field research vary across scientific disciplines, but social scientists usually interview or observe people in their natural working or living environments to recognise attitudes or behaviours and other features. Fieldwork "involves a range of well-defined, although variable, methods: informal interviews, direct observation, participation in the life of the group, collective discussions, analyses of personal documents produced within the group, self-analysis, results from activities undertaken off- or on-line, and life-histories" (https://en.wikipedia.org/wiki/Field_research). All of the above methods can be described as components of qualitative approach, which is an important feature of field research; it opens an opportunity for a wider interpretation of a given phenomenon or investigated processes. The above understanding of fieldwork is perceived by investigators rather as one describing a "location" of research. From participating students' point of view, more "activating" is a term problem-based learning as it suggests their meaningful role in solving a real problem. "Problem-based learning (PBL) is a student-centred pedagogy in which students learn about a subject through the experience of solving an open-ended problem". (https://en.wikipedia.org/wiki/Problem-based_learning#cite_note-Schmidt_2011-2). This method gives students an opportunity to learn both thinking strategies and domain knowledge. It also helps students to develop their flexible approach to effective problem solving, on the one hand, and to create an ability to improve knowledge, on the other hand. New skills acquired thanks to self-directed learning and effective collaboration strengthen social competence and specific skills of working in a team. An opportunity to work in groups open students a way to identify their current level of knowledge and to formulate a niche for further information which is necessary solve the problems. This active learning method has been changing the role of the teacher; he (she) is a person who influences the learning results by supporting, guiding, and controlling the learning process. The teacher is also obliged to built students' self-confidence about their ability to address a problem and to stimulate them into creative approaches, while also stretching their understanding of a real problem. Problem-based learning is an example representing a new teaching paradigm, which could be observed as a shift from a lecture-based philosophy to the real world problem solving philosophy. According to Sztabinski et al. (2005), fieldwork is an art. This statement suggests a need for a selection of methods applied and an improvement of work methods consistent with changes in the environment. According to Barrett (2016, p.35), "Within the past few decades, we have seen the metamorphosis of the traditional classroom setting transform into a virtual one". This direction of development in higher education for tourism requires a combination of work in the real world with e-learning; a specificity of the tourist as a consumer who invest his/her free time and money creates a space for understanding of real processes in the industry because virtual education cannot be seen as one explaining tourists' behaviours and attitudes clearly enough. Consequently, based on e-learning students of tourism could not be able to fulfil consumer expectations.

E-learning is often defined as "The delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or an electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material" (Stockley, 2003). The literature also stresses a value of blended learning. Tick (2006, p.443) points out: "The nowadays trendy term blended learning is used to describe the combination of online tutoring or mentoring, self-paced learning and 'conventional', offline, face-to-face approaches. It can successfully combine the advantages of e-learning with rigorous practice, correction and guidance face-to-face with a teacher in a classroom using the combinations of technology-based materials and traditional print materials".

The above approaches open a space for the research question of this study: Is the combination of e-learning and traditional teaching an effective educational method for tourism students?

The purpose of this study is to conceptualize fieldwork as problem-based action-learning in both the national and the international context; when formulating the objectives, different cultural backgrounds of international students has been taken into account. The national perspective of conceptualisation was mainly based on education programmes for tourism in Poland. A comparison between two cases of international fieldwork organised in Gdansk in Poland shows a necessity for constant communication of students from different countries. This helps to improve the concept of solving a problem and stimulates sharing knowledge.

## 2. Is fieldwork an appropriate educational approach for tourism?

Rapid growth of travelling since the beginning of the 1980s has become an important factor of a new tourism paradigm; both tourists and the tourism sector have been involved in the process of service quality improvement. New tourism products have changed consumption patterns, increasing the market share in the global competition; tour-operators have become rather customer oriented and compete using mainly non-price factors in a strategic approach to customer satisfaction. The role of customer-perceived quality in generating profits has been recognised by tourism enterprises which adopted quality management in service production and distribution. As a consequence of changes on the tourism market, modification of tourism education has become a necessary solution, as students must understand tourists' needs on the one hand and of the tourism business on the other hand.

Tourists and service providers meet each other on a basis of different cultural backgrounds (Grobelna & Marciszewska, 2015). Differentiation of attitudes and behaviours on both sides can lead to conflicts. Therefore, cross-cultural aspects of service in tourism have to be taught to students intending to work in the sector. It is connected with the fact that service expectations of tourists are determined by a national culture; it creates a need for cultural education during tourism studies because students, as potential deliverers of the service (e.g. working in hotels), have to possess knowledge on service quality. They should be able to create interesting service products which could satisfy tourists independently of their national and cultural background (the supply side). Experiential learning can bring them knowledge which creates tourists' satisfaction. This requires a different pedagogical approach from that usually adopted in tourism education (Faché, 1998, 2000). Unfortunately, some research findings suggest that teachers often do not support educational reforms. Avidov-Ungar's study (2016, p.117) presents "four 'types' of teachers differing from each other in how they experience and deal with the reforms. All four 'types' of teachers strongly believe that extensive reform is needed, but each needs different supports to lead the change". If this is the case for tourism education, traditional learning should be replaced (or at least supported) by e-learning; it is necessary because the dynamics of tourism drives the education. Fieldwork, as a specific method in education, drives experience from both traditional learning and e-learning.

## 3. International fieldwork – a case study

Internationalisation and globalisation of tourism as both economic entrepreneurship and human leisure activity necessitates development of employees' skills in the sector. Rapid growth in employment in this branch of economy as well as in tourism demand opens a new dimension for research and education: how to stimulate tourist consumption and improve customer satisfaction. Both aspects require a deep competence in personal communication. Face-to-face relations between service providers and tourists are shaped by both organisational and personal culture which could be re-created during fieldwork. Common work of students and professors representing different universities builds a new environment; it would be a challenge for an innovative methodological approach in educating for the tourism sector. Faché (1996, 1999) has already adopted fieldwork as a learning method for tourism education, but he stressed the importance of sharing knowledge and experience rather than its communicative function.

The author of the present article, as a professor at Gdansk University of Physical Education and Sport, was responsible for organisation of the first international fieldwork for students of this University financed by the European Commission in 2001-2003. The project itself was innovative in two aspects: experimental and organisational ones. A potential value of the experimental approach for education for tourism was discovered as a niche by the participating Universities: University of Ghent, Fachhochschule Bremen, Gdansk University of Physical Education and Sport, the University of Gdańsk, Kalmar University, the University of Malaga. The project focused only on education for cultural tourism, but it discovered different backgrounds of students and different communication skills as a limitation of successful work in teams. International students participating in ten-day fieldwork undertook quite a difficult task driven from the real world: they had to analyse functions of cultural tourism packages offered in Gdańsk travel agencies and to create new products based on previously collected information. The questionnaire survey on the selected cultural attractions of Gdansk City was carried out, and managers of 2 hotels and two tour operators were interviewed. Students were obliged to develop strategies for improving the quality and innovations in cultural tourism.

The organisational innovation of the fieldwork was represented by networking of the Universities and financing by the EU: the project was coordinated by the country which was not a member of the EU. Polish HEI Gdańsk University of Physical Education and Sport took on itself a general managerial function concerning the project; it was an unusual solution at that time when a non-member country was responsible for running a project which was financed by the European Commission. The first fieldwork was held in 2001 in Gdansk and it was designed as part of the three-year Socrates Intensive Programme. This contained lessons given by teachers and tasks for students: adapting the existing questionnaires for an evaluation of customer expectations in hotels, interviewing and processing data concerning cultural events in Gdansk. Creating a cultural holiday package for tourists potentially coming to Gdansk was the students' final task (Fache, 2003).

## 4. The concept of problem-based action-learning: Challenges of fieldwork

The fieldwork was conceptualised as problem-based learning (PBL). The concept of this approach is based on work in a real world with real problems which have to be solved (Barrows and Tamblyn, 1980). Students work on the campus on real projects for real clients with real budgets and real deadlines (Remer, 1992; Fache, 2003). According to Boud and Feletti (1999, p.2), "PBL is a way of constructing and teaching courses using problems as the stimulus and focus for student activity".

The fieldwork Gdańsk 2001 was focused on marketing research in culture and tourism; student teams solved real problems for real clients in problem-based fieldwork. They conducted their questionnaire survey in two 4-star hotels and three cultural attractions: the Cathedral in Oliva, the Pier in Sopot, the King's Road in Gdańsk. As a consequence of collaboration between students and hotel managers, the research results were subject to assessment at universities but also contributed to the hotels; the data collected among tourists and visitors could support tourism organisations and enterprises. Therefore, Fache's (2003) statement: "The problem-solving fieldwork will therefore be best carried out with the collaboration of business (hotels, boat trips operators, tour-operators), and governmental organisations (tourist offices, museums), providing the real-world problems that need to be researched, analysed and solved" expresses the real value of fieldwork as an educational method which can support commercialisation of collected data.

Every educational event has to meet its objectives. In traditional methods of teaching and learning tutors have a responsibility for the quality of teaching materials, presentations and, finally, results of the studies. In fieldwork professors play a supportive role, but a real-world problem depends on many factors shaping its environment. Tourism product management requires a constant improvement in staff's skills; this could be achieved in fieldwork thanks to collaboration between students and professors, on the one hand, and a reference to the real world, on the other hand. Students have an opportunity not only to "touch" a problem but they are usually involved in the process of solving the problem. They can gain new experience leading to new knowledge. The purpose of a fieldwork project was firstly, effective experimental learning for students, and secondly, beneficial to all the participants. These requirements emphasise an importance of students' competence in a service design, on the one hand, and good communication abilities, on the other hand. It is strongly connected with a need to work in a team during problem-solving fieldwork. An international team creates additional communication barriers; its members must work together on a new topic using English. By contrast, in traditional teaching a student is working primarily alone because working in a team is usually not a criterion of final assessment in a class. The real world problem necessitates students, industry and university working in a team to solve the problem. The team in the fieldwork Gdańsk 2001 was multinational with different educational backgrounds and different stages of study. Therefore, it was also an advantage for persons who played a role of a leader in the team. Peoples from different countries who work together in the same environment create specific interactions but they can also built special relationships during their working time.

### 4.1 A role of distance learning in the fieldwork

Distance learning was used to introduce students into real-world problems tourism faces nowadays. The educational sessions held virtually with professors helping students:

- to gain knowledge about Gdansk as a tourism destination
- to recognise differences between traditional teaching, on the one hand, and e-learning, on the other hand;
- to share past tourist experience with other students participating in the "virtual company"
- to prepare a team to new tasks in a new teaching and cultural environment
- to recognise a value of internationalisation in education and its importance in the decision-making process.

Data showed a gap between previous knowledge of the staff in the investigated enterprises and new facts which had been unknown to managers before. The survey results from the two hotels showed differences between their clients' expectations: different market segments were characterised by different service attributes. This was demonstrated by findings from both the hotel with predominantly leisure travellers and the hotel for business travellers.

## 5. Students' evaluation of the fieldwork 'Gdansk 2001' project and e-learning in the Euro 2012 research fieldwork

The evaluation of the fieldwork by participating students gave very positive scores; this is a sign that learning objectives have been achieved. The overall mean (score) was 4.3 (max.5) for 12 objectives. The following objectives received the highest grades (4.9): work with people from different countries; understanding that quality in tourism means fulfilling the tourists' expectations and needs; the expectations can be different depending on the nationality or cultural background of the tourist. Weak points were expressed by lowest grades of the objectives: designing a questionnaire to evaluate the quality of tourism services (3.4) and applying various research methods to understand customer's expectations and perceptions of services (3.6). These objectives were given less attention by the teachers, because of time constraints. The scores suggest that the fieldwork was insufficient to teach students methodological issues. The evaluation discovered a niche for using complementary educational methods: e-learning prior to the fieldwork should better prepare students for understanding and using methods and instruments improving the service quality in tourism. Students and teachers realised that all the insufficient learning results are related to the lack of appropriate preparatory work based on e-learning at the home university before the fieldwork. The fieldwork can then focus on an understanding of the concept of quality management and help to apply research methods to understand customer's expectations and perceptions of services, in particular interviewing and processing the questionnaires.

As nearly all students (23) declared participation in similar fieldwork in the future, necessary changes were implemented in the programme for tourism students both in the Intensive Programme and at Gdansk University of Physical Education and Sport. Based on the fieldwork experience, the content of this module was updated and developed during the second year to create an online learning environment. Next two years of the Programme contained tasks strongly connected with creating and using an international virtual learning environment.

The distance learning approach to the preparation of the fieldwork helped the students to prepare themselves at the home university and it was helpful to bring students to the same knowledge level before the fieldwork started (in Gdańsk and Bremen). The fieldwork experience delivered knowledge on necessary programme development in higher education for tourism. A constant access to the Internet opened the door to a new approach to teaching. Traditional methods of lecturing have become less attractive than on-line sources because of a possibility to find literature on the same topic written by different authors in quite a short time. In the case of tourism theory, virtual travelling could support a learning process by using means of visual communication. These intangible assets of knowledge were used at Gdansk University of Physical Education and Sport in planning research fieldwork during Euro 2012. A conceptual framework for the research on tourists' expectations and satisfaction was prepared by the University's research group led by the author of the present article as a common project with the Mayor's Office in Gdańsk (Wojdakowski et al., 2014; Wojdakowski et al., 2015). Students did not attend the conceptual stage of the project, but they participated in preparatory meetings organised by the Office. Prior to the fieldwork held on June 8$^{th}$ – June 23$^{rd}$, the Internet was used as the main tool for communication of both research teams and students, taking into account that "Information and knowledge useful to tourism researchers and marketing professionals can be retrieved from various sources or types of media" (Xiao and Smith, 2010, p.410). The Internet as an additional source of information about previous studies on tourists' attitudes and behaviours during mega sport events was used by the researchers. Thanks to this medium, they could achieve the following goals:

- the questionnaire was developed in its final version in Polish;
- the translation process was completed using the Internet communication and new versions of the questionnaire were provided in English, German, Spanish, Croatian, and Russian;
- supportive correspondence concerning the fieldwork, e.g., permissions and schedule of the fieldwork was distributed via the Internet and it was a basis for decision making;
- operational correspondence during the fieldwork was distributed via the Internet;
- the final research report was delivered to all the working team's members in an electronic form and it was accessible on-line at the Mayor's office website.

Students also were prepared to the fieldwork using the Internet communication. Particularly, they gained:

- an ability to recognise necessary changes in the survey process thanks to exchange of experience;
- skills of operational re-scheduling in situations when objective circumstances made the survey impossible in a given place or in the planned time;
- an ability to plan the survey in different, often unpredictable, spatial circumstances.

The above features of the research fieldwork realised during the Euro 2012 in Gdansk justify the conclusion made by Barrett (2016, p.40): "while online learning has been in its embryonic period for a short time, it has been transforming and changing". In the case analysed in the current paper the first fieldwork was based on Polish students' very limited access to the Internet, hence they could not have sufficient results on working in a virtual company. The fieldwork which was held over ten years later presents a changing role of this medium in both education for tourism and students' attitudes towards e-learning. This method supports achieving the major educational goals (Mayades and Miller, 2016): improving access for students who are not otherwise able to attend a traditional, campus-based program; improving the efficiency and effectiveness of education by using e-learning media and methods to control costs; improving student choice over when, where, and how to engage in the learning process.

## 6. Conclusion

The Internet being an unquestionable source of information and an important tool of virtual communication plays a vital role in the process of education development for tourism. Its value lies not only in the 24/7 accessibility but also in an opportunity to retrieve very actual information about the tourism sector. This feature "decides" about expedience of using the Internet in a teaching and learning process for tourism. However, there is not a straight answer to the question: is it possible to rely on an exclusive application of e-learning? This could be seen as a research question for the future as the above two examples of fieldwork combined with e-learning rather suggest a complementary role of this method in tourism education, as problem-based learning is a process of discovery "that is much more open to sensitive and reasoned activity than […] education inhibited by a separation of discovery from justification" (Margetson, 1999, p.43). E-learning has improved the quality of the educational process, on the one hand, and developed students' skills of recognising changes in an environment and of reacting to them.

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# Mobile Gaming Experience and Co-Design for Kids: *Learn German With Mr. Hut*

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**Abstract:** Recently, game-based learning and mobile learning have become increasingly important for their significant contribution to education. Game-based learning (GBL) environment combines appropriate gaming technology and didactic strategies, in order to provide engaging learning experiences. In addition, interactive mobile learning provides learners with deeper and meaningful learning experiences, which are extremely effective for language learning. As some important researches and learning theories show, innovation in learning is also represented by engaging learners into game design processes, in order to enhance learning through a stimulating and motivating strategy. The aim of the purposed research is to prove the effectiveness of an innovative strategy of learning, combining Mobile-GBL with a co-design methodology. Our research focuses particularly on foreign language learning. In order to provide a deeply involving learning experience, a co-design methodology was adopted for the development of the game "*Learn German with Mr. Hut*". In addition to that, the videogame was built with HTML5. The purposed game immerses 6 to 12-year-old learners in educational challenges focusing on German language learning. The focus group has been engaged in all the phases of the project. During the first phase, co-design sessions aimed to engage pupils into the design process of the game. After the development of the game, the focus group was engaged to test the game. This experiment took place in some Italian schools. The last phase consisted in evaluating questionnaires, which allowed pupils to express their opinions and views about the game. The results of our research reveal the effectiveness of a combined learning strategy, involving co-design methodology and a mobile game-based learning environment. The analysis of the scores of the game highlights the efficacy of our game for learning and teaching German, suggesting how foreign language learning can be successfully enacted in mobile game-based learning environment combined with a co-design methodology.

**Keywords:** e-learning, game-based learning, mobile gaming, multidevices, Html5, co-designing, language training

## 1. Introduction

In the past decade, there has been a huge increase of researches on Game-Based Learning. GBL environment actively engages learners, and enhance their motivation and interest. As previous researches show, the application of games in learning is particularly effective in language learning (Dourda, 2012; Jacob & Isaac, 2008; Huizenga, et al., 2009) because GBL approach is more intrinsically motivating than non-gaming approaches (Dourda, 2012, p. 156). This is especially true when GBL experiences are provided through mobile devices. Besides the mobile game-based learning, the co-design methodology represents a further enhancing strategy for learner's involvement in the learning context. All these methodologies are extremely innovative in the field of education and technological application.

This paper aims to explore the efficacy of mobile game-based learning combined with the co-design methodology. In the course of this paper, we focus especially on language learning. The framework for our research study and the purposed game-project will be explained in more detail below.

## 2. Game-based learning and designing

### 2.1 Game-based learning

The real value of game-based learning is to create meaningful learning experiences (Kapp, 2012), capable of empowering learners' engagement and positive learning outcomes. Since studies show that motivation has a deep influence on learning process (Prensky, 2001; Kyndt, 2011), the mechanics of game-based learning environment are consistent with the model of the Self-Determination Theory (SDT) (Deci & Ryan, 2002). According to Deci and Ryan (1985), an engaging learning environment bases on intrinsic motivation, which is closely linked to the concept of *learning by doing* (Kirkpatrick, 2008). The core element of *learning by doing* strategy is experience, insofar as it empowers learning goals' achievement (DuFour, et al., 2006). Moreover, it actively engages students in hands-on exercises, promoting experiential learning (DuFour, et al., 2006, p. 1).

Studies show that experience-based learning benefits of the connection between personal experience and learning process (Dewey, 1998), and builds upon opportunities of activity (Piaget, 1951) and creativity (Vygotskij, 2004), which are both provided by games. In addition to that, the experiential education aims to combine "multi sensor stimuli with practical learning […] making use of emotional incentives and learning strategies in order to facilitate development" (Hildmann & Hildmann, 2009). Virtual contents' structure employs and offers a combination of various forms of media and emotive stimuli that reduce cognitive load (Moreno & Mayer, 1999). Relying on the Contiguity Principle (Mayer & Anderson, 1992), Moreno and Anderson state that a multimedia instruction (i.e. when pictures and words are integrated in time or space) and game-based learning environment concretely represent an innovative way to motivate and enhance apprenticeship, its processes and its outcomes (Antinucci, 1993).

#### *2.1.1 Mobile gaming for language learning*

The development of technology has been changing traditional didactic approaches. Computer games in GBL environment are effective because learning is applied and embedded in a meaningful context, where learners are actively involved and encouraged to find solutions or to make decisions during the game (Dourda, 2012). One of the most important innovation about GBL is linked to the increasing use of mobile devices (Marengo & Pagano, 2016). This phenomenon enabled researchers and professionals to come up with some of the most innovative applications of mobile to different contexts and fields. As previous studies show the relationship between interactivity and learning (Sims, 1995; Kwok Chi & Murphy, 2005; Bailenson, et al., 2008), an appropriate use of mobile devices can useful support educationalists' work and enhance positive learnings' outcomes (Hildmann & Hildmann, 2009). This is due to the fact that "Mobile learning" (Marengo & Pagano, 2016; Koole, 2009) represents a more attractive, flexible and interactive way to learn (Jacob & Isaac, 2008). It builds upon the comparative analysis of multimedia's elements of the Theory of the Dual-Coding Systems (Paivio, 2014) and it deals with the adaptive functions of nonverbal and verbal systems that deeply contribute to learning processes. This is notably strong concerning language and learning evolution. The use of mobile devices particularly stimulates dual-coding memory which is implicated in language learning (Cardona, 2010) and therefore, it fits well for language apprenticeship (Cardona, 2010).

Previous researches on mobile learning show the deep impact of the daily use of mobile devices on learning and assess the positive approach of students towards the use of mobile devices in learning contexts (Kukulska-Hulme, 2009; All, et al., 2013; Kiili et al, 2013; Sandberg, et al., 2011).

### 2.2 Co-Design

The design of everyday things is not always responding to users' expectations, leaving them frustrated and disappointed. For this reason, co-design methodology is increasingly taking hold in the game industry, aiming to gather opinions and ideas from a specific focus group, in order to create a "product" responding to users' interests and expectations. It generally refers to Norman's "User-centered design" (1986), stating the usefulness of involving users in the design process. This methodology allows exploring the desires and the interests of users, influencing the development and the final shape of the product. Co-design methodology offers several advantages, such as more efficiency, effectiveness and safety of the product, the development of a sense of users' ownership for the product and the generation of more creative design solutions and/or alternatives (Abras, et al., 2004). According to Abras et al. (2004), when the users are placed at the centre of the design, they develop a sense of ownership for the "product". Moreover, the Psychological Ownership Theory (POT) by Beggan (1992) explains how the relation between the object and its owner is deeply marked by emotions. Since emotion represents one of the basic elements for motivation in learning contexts (Prensky, 2001), the co-design methodology may represent an educational innovation, which is capable to enhance learners' involvement and improve learners' outcomes.

The idea of co-design methodology as a learning motivator is tackled in various researches. All, Van Looy and Nunez Castellar (2013) highlight that co-design sessions are useful in exploring opinions of the target audience and broadening the designers' perspectives. Enabling learners to be self-directed learning designers represents an efficient way to involve students in learning processes (Laerke Weitze, 2015). Vaajakallio, Jung-Joo and Mattelmäki's (2009) research focuses on the application of the co-design methodology on a group work, composed by children, basing on the fact that children "grow surrounded by technology" (Vaajakallio , et al., 2009, p. 246). Relying on this principle, we have applied this innovative methodology for the development of the language learning game "*Learn German with Mr. Hut*".

## 3. Methodology

A mixed approach was adopted. On one hand, a qualitative approach was adopted in developing the project game "*Learn German with Mr. Hut*", especially for the co-design sessions and the evaluating questionnaires. On the other hand, a quantitative method was adopted in exploring the background habits of the learners about learning through games during the co-design sessions.

### 3.1 Co-design sessions

Co-design sessions based on questionnaires, asking learners:

- to express their habits about playing at videogames using IT devices (PC, tablets, smartphones), their preferences, their tendencies and their opinions about learning didactic contents through a game-based environment;
- to actively participate into designing-sessions. We proposed some characters without attributing them any specific role. Therefore, pupils could give their opinions about the characters that our team had previously projected and drown.

#### *3.1.1 Participants*

A focus group composed by primary school pupils ranged between 6 - 12 years was selected for the co-design sessions. 46 pupils from a Year 2 class (27) and a Year 5 class (19) took part in the project. Pupils are Italian speakers without any German language skills.

**Table 1**: Number of participants per years class and genre

| Year Class | Male | Female |
|---|---|---|
| Year 2 Class | 13 | 14 |
| Year 5 Class | 10 | 9 |

#### *3.1.2 Co-designing procedure*

A daylong session took place in April 2016 in the Secondo Circolo Didattico "Via Firenze" and "Via Guglielmi" schools – Conversano, Italy. After a brief presentation of our team and icebreaking conversations with the children, pupils have been divided into two groups and the co-design session could start. This choice is due for the insufficient number of tablets available for each the session. Each pupil has been given a tablet with the questionnaire on display, so he or she could start answering the questions and co-designing the project. The co-design sessions took 1 hour per Year Class.

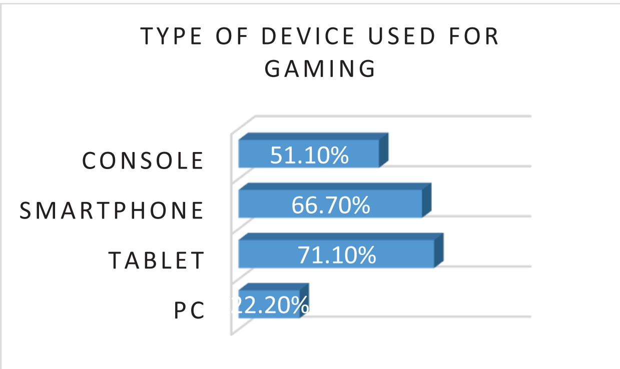


**Figure 1**: Type of device used for gaming


**Figure 2**: The % about learning through games

#### *3.1.3 Co-design results*

The results show that more than a half of pupils has access to consoles, tablets and smartphones for gaming. The findings that the 66,7% of pupils uses smartphones and the 71,1% uses tablets is particularly interesting. These results prove how pupils concretely prefer mobile devices to PC or consoles for gaming. In addition to that, the 97,7 % of pupils would like to learn school subjects though games. Both these findings are of great benefit to our study research. On one hand, they confirm our expectations about the potentiality of games in learning contexts; on the other hand, they assess the huge ownership and usability of mobile devices by children. Moreover, pupils are asked to give their opinions about some characters that our team had previously drown. Basing on these results, the team could finally start developing the game.

## 4. The "learn German with Mr. Hut" game

As explained above, the language learning game "*Learn German with Mr. Hut*" has been developed based on the results of the co-design sessions.

### 4.1 Game development

The development of our game project is based on a co-design methodology. Co-design sessions' results have been implemented in the project as follows:

1) During the co-design sessions, the pupils is given the opportunity to express their opinions, to propose alternative ideas, to evaluate and attribute a specific role for each character; these results have been implemented in the development of the game.

2) In the questionnaires, specific information about the trend in Information Technology and mobile devices are asked. Based on the results, the research team focused on the development of the learning object using HTML5 technology with a mobile and user friendly User Interface. The research team involved in these steps is from Osel s.r.l. (Open source e-learning): it is a spin-off company of University of Bari involved in "e-learning revolution" - an innovative way of re-think e-learning design methodology. The team was involved in some main phases:

- Storyboarding (according to co-design sessions' results)
- User Interface and graphic design development
- HTML5 coding and output
- In vitro test
- In vivo test.

Starting from what emerged during the co-design process, screenwriters have built the storyboard, composing a complete script of texts and speech, which would be then submitted to the scrutiny of the development team for additional brainstorming and approval of the technical feasibility. The storyboard was used in the later stages as a guide to follow in order to ensure that the output is in accordance with the technical and didactic provisions. In the phase of graphic development, the designers made the graphics and produced scenarios in accordance with the game theme. In this phase, the user experience and the usability on mobile devices were taken in account. Once the graphic was ready, it was assembled inside a fully responsive or adaptive interface that allows the enjoyment of the game in any web browser from both desktop and mobile. The output released is in SCORM format suitable for any e-learning platform (LMS), which helps to track student activity and performance inside the learning object and through the learning platform. The flexibility of the HTML5 language allows to build the application code as mobile APP or similar to a website that can be run on any web browser.

After the development process and when the game was released, the research team started an "in vitro" test, in order to assert the functionality and consistency of the project with the expected content previously defined in the process of analysis and design. In this phase, testers and developers reported and fixed some bugs, and then performed a "fine tuning" process starting from the performances and usability levels measured on different devices on which the game will be distributed to improve user experience.

At the end of these stages, the game package was ready to be distributed for the "in vivo" testing and evaluation in deep described in the following paragraphs.

### 4.2 The description of the game

The game builds upon a narrative structure. It is divided into two sections: 1) cutscenes; 2) interactive game. During the cutscenes, the player is explained the circumstances in which he or she is going to be involved in. Its details are explained below.

### 4.2.1 Didactic material

The videogame is composed of three levels with one didactic game each. Mr. Hut - a sort of guide of the learner - and a specific character for each didactic level introduce the pupil to each game level.

**Table 2**: Storyboard of the "*Learn German with Mr. Hut*" game

| | |
|---|---|
| Background story (non-interactive story) | Non-Playing Characters: Teacher, Mr.Hut, Avatar<br>On a spring day a new school day is going to begin. The bell rings and the Player is going to attend his or her second German lesson. The player is given the opportunity to take the choice between male or female avatars. The player goes to the classroom. The German teacher starts questioning and the learner has an oral exam. The Player does not have any knowledge in German language. For this reason, the Avatar of the Player says: "I really need some aid…". Suddenly, the spacetime coordinates are broken up and the Player is carried into an imaginary world. A funny hat, whose name is Mr. Hut, comes to his or her aid. At this point, the interactive game begins. |
| Level 1 | Game type: *Spot the difference*<br>Non-Playing Character: Ted<br>The Player must find the differences between two otherwise similar images. When clicking the correct difference, the object is displayed on the right side, the word is shown in a box grapheme card under the object and the pronunciation sound is played automatically. |
| Level 2 | Game type: Memory<br>Non-Playing Character: Kanin-Chen<br>All the cards – with the objects, the graphemes and the pronunciation sounds - are shown at the beginning of the game, and then they are faced down. The Player must find the correct pair of cards. |
| Level 3 | Game type: Drag & Drop<br>Non-Playing Character: Teacher<br>All the objects of the previous games and their corresponding graphemes are laid out in two columns on display. The Player must find the correct matching between the objects and their corresponding grapheme. At each correct matching, the pronunciation sound is played. |

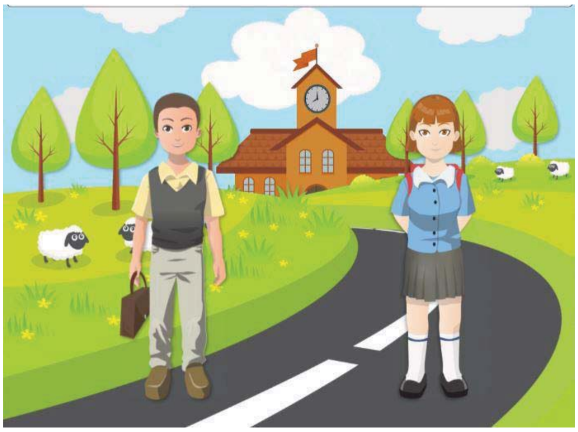

**Figure 3**: Screenshot - choice of the learner's avatar

**Figure 4**: Screenshot - Introduction of the character Kanin-Chen to Level 2

## 4.3 Game testing and evaluation

In order to assess the effectiveness of our game project, we conducted game sessions with pupils in May 2016, which consisted in two different phases:

- Game testing. It involved the same focus group, which was engaged in the co-design sessions. Pupils have been divided into two groups. This choice is due for the insufficient number of tablets available for the session. Each pupil has been given a tablet. At the end of the game, pupils could view their "repot card", where they could find detailed information organized into Levels about their performance in the game;

- Evaluation survey. This last phase aimed to allow children to evaluate the game, to express their opinions about its effectiveness and its involving power. Moreover, pupils are asked to suggest alternatives, new solutions or to make criticism about the game.

The game testing sessions took 1 hour per Year Class.

**Figure 5**: Game-testing session in the Year 5 Class

## 4.4 Results and discussion

### *4.4.1 Game testing results*

Game testing results show how Level 3 is more difficult for learners than Level 1 and Level 2. During the game testing sessions, it emerged that pupils matched easier and faster words such as Apfel (apple), Buch (book), Lineal (ruler) and Zug (train) rather than other words, such as Blumen (flowers) and Bleistift (pencil). It may depend on the similarity of these words in pronunciation in English (e.g. “Apfel” - apple; “Buch” - book), on word and pronunciation association with other languages (the German word “Lineal” is similar to the English word “line” and the Italian word “linea”), and/or on word length (“Zug” is a very short word and easy to remember). According to pupils, the words “Blumen” and “Bleistift” are harder to learn because they are similar to each other in pronunciation and cannot be associated with other Italian or English words. Anyway, the majority of pupils (84,8%) matched these words correctly because they remembered of the object and the corresponding box grapheme card. The rest matched them correctly by exclusion (15,2%).

As the results show, the percentage of pupils who remembered the German words and matched them correctly is very high. In order to verify our expectations about the purposed research, pupils are asked to explain why they answered the way they did. Pupils explained that they remembered clearly the German words and the object the way they were displayed on their own tablet. They also remembered well the pronunciation of the words, which supported them in solving the game.

Since German is one of the most difficult European languages, such a result contributes to confirm that Mobile-GBL may concretely provide an innovative and motivating way of learning, facilitating the learning process and allowing the learner to overcome learning hurdles.

### *4.4.2 Game evaluation survey results*

Once the game testing sessions finished, pupils were asked to answer to specific questions about the game. In addition to multiple choice questions, the survey includes open-ended questions, in which learners can express additional opinions. Firstly, all children said that they liked the videogame (100%). We also asked pupils to choose from a checklist one or more adjectives, better describing the game. 41,3% of pupils defined it as “interesting”, 63% as “funny” and 82,6% as “motivating”.

These results confirm that a funny way of learning can be an interesting and a motivating way of learning at the same time. 100% of pupils stated that the videogame "*Learn German with Mr. Hut*" may be considered as useful to learn German as a foreign language. Moreover, pupils were asked to propose other subjects that could be learnt through this videogame.

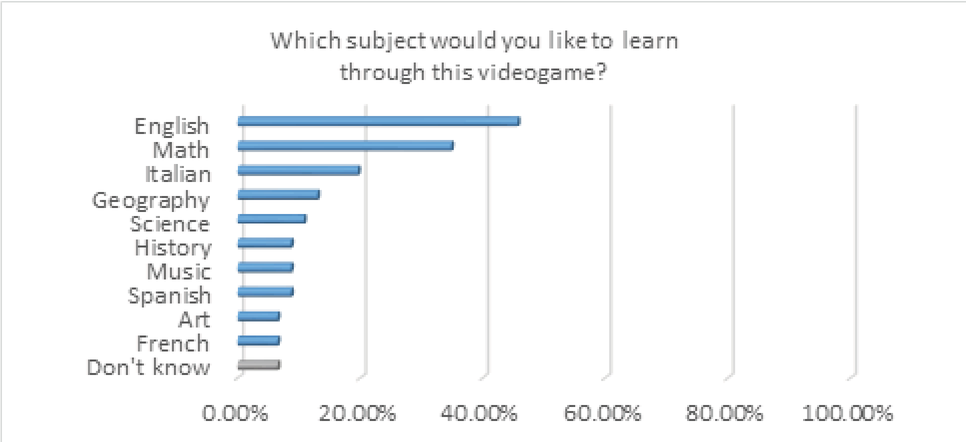


**Figure 6**: Graphic – proposals of pupils about adapting our project game to other subjects

According to a research study conducted in 2014 in Turkey (Dündar, et al., 2014), the most difficult subjects for students and pupils are Math and Turkish as a first language. As shown in the graphic above (Figure 6), the three subjects on the podium are English, Math and Italian as a first language. Such a similarity is extremely important for the evaluation of the results of our research because it confirms the interest of pupils in innovative learning methodologies that could support learning and enhance their knowledge, especially on difficult subjects.

### 4.5 Observations

Beyond the game-testing and the evaluation survey results, pupils' behaviour during the test "in vivo" was observed. During the game-testing, children were really engaged in playing the videogame. They recognized the characters of the game and they remembered about some details of their participation to the co-design sessions. This aroused their curiosity during the playing session, thinking out loud about the characters and in particular about "what happens next" in the game. Furthermore, they loved the background story and the learning games.

In regard with the learning contents, pupils were interested in what they learned through the game and very proud to show us their improvement. Once the game session and the evaluation survey were concluded, we asked pupils to tell us which German words they remembered. They listed 4 out of all the German words of the videogame (the total number is 6). This is a very important result for our research study because it definitely assess the effectiveness of learning German through a mobile game-based learning context. Finally, when asked pupils how to improve our game project, most of them have proposed to insert new characters and new levels. A longer game seems to be the best solution for the focus group. Such a good idea may be taken into account for further work.

## 5. Conclusion

As stated above, this paper aims to assess the effectiveness of mobile game-based learning strategy combined with the most innovative co-design methodology. Our team developed the game "*Learn German with Mr. Hut*" for this purpose. As already mentioned above, co-design sessions were extremely useful to explore pupils' interests, in order to build a deeply motivating learning game and provide a game responding to pupils' interest. Moreover, the game has already been tested through hands-on testing sessions and evaluation survey questionnaires, aiming to gather pupils' opinions and views about the game. The analysis of the evaluation survey results assesses the effectiveness of the mobile game-based learning combined with co-design methodology and highlights the power of this approach in enhancing learners' motivation and facilitating language learning.

The diffusion of IT culture have changed society completely (Marengo & Pagano, 2016) and education is influenced by the social culture (Holiday, 1994). Thus, learning methodologies must be appropriate to the social context we live in. As IT provides learners with a variety of innovative learning methodologies, the efficacy of the combination of different learning and teaching strategies should be taken into serious consideration. According to Biggs (1987), the combination of various learning strategies enhance successful learning outcomes. While this paper focuses on foreign language learning, the purposed approach can be applied to various learning contents types. For this reason, the purposed learning approach combining mobile game-based learning strategy with a co-design methodology can be a winning combination for a successful learning. Thus, the purposed research can be considered as a starting point for further works in this field.

## Acknowledgements

We wish to thank the Secondo Circolo Didattico “Via Firenze” School and “Via Guglielmi” School - Conversano, which volunteered for the co-design sessions and for the test of the purposed game project. We would also like to thank Osel S.r.l. – E-learning revolution, which supported the development of the project in all its phases.

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# Recording, Publication, Testing and Evaluation of Quantitative Knowledge in e-Learning Environment

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**Abstract**: One of the burning questions in majority of universities in the Czech Republic is maintaining and increasing the teaching process quality at permanently growing interest in university studies. Implementation of eLearning technologies indeed has been of a great assistance while addressing the stated issue however it is obvious, that conventional text study supports cannot fully substitute direct or mediated interactions of teaching staff with student. The complex rich-media visualization of the tutorial process becomes the absolute necessity for the overall transfer of information from the teacher to students. The issue of key aspects of implementing rich-media technologies at VŠB-Technical University of Ostrava in the Czech Republic is dealt with the MERLINGO Project (MEdia-rich Repository of LearnING Objects). Using rich-media technologies allows to carry out automated complete records of the whole educational process with minimum demands on financial, time, personnel and technological costs and to achieve their immediate access in the environment of LMS Moodle. Testing, evaluation or practicing students' knowledge especially in quantitative subjects such as mathematics or statistics can be also facilitated using LMS Moodle. The module Test, which is a standard part of commonly used e-learning environment LMS Moodle, is not very suitable for developing mathematical or statistical tests because it contains only a limited number of functions that can be used for creating quantitative tasks. At VŠB – TU Ostrava we have chosen the R language and Sweave and Exams libraries for generating quantitative tasks. Texts of tasks are created in the markup language LaTeX. Using the Exams library the tasks can be compiled and exported to PDF format or Moodle XML format. The eLearning methods described above entail a number of both technical and didactic problems and difficulties. The paper pointed out some of these problems and how the authors have dealt with them. The authors also present selected results of research among students who have already passed some eLearning courses containing these methods and tools.

**Keywords**: quantitative knowledge, rich-media, testing and evaluation, LMS Moodle, Exams library for R

## 1. Introduction

Current educational process makes even greater demands on the students' self-reliant work independent on school timetable. Utilization of eLearning technologies should become one of crucial factors for making easy these students' efforts. This paper introduces two different eLearning methods, which are used at the Faculty of Economics, VŠB - Technical university of Ostrava. Problems, difficulties and challenges connected with those methods are presented.

## 2. Rich-media technologies for recording of teachers' presentation and their publication in the LMS Moodle environment

One of the burning questions at majority of universities in the Czech Republic is maintaining and increasing the teaching process quality at the permanently growing interest in studies. Using of eLearning technologies generally has been of a great assistance while addressing the stated issue however it is obvious, that conventional eLearning text study resources cannot fully substitute direct or indirect interactions of teachers with their students. The complex rich-media visualization of the tutorial presentation thus becomes the absolute need for the overall transfer of the taught content from teacher to students (Martiník, 2012).

The term *rich-media* is a synonym for the digital interactive multimedia. Rich-media includes audio, video, or other elements that encourage users to interact with the content. Rich-media are often used for the support of synchronous and asynchronous type of bidirectional communication, through which it is possible to share and transfer the digital content and communicate interactively in the real time. The characteristic feature of the rich-media technologies is their support of dynamics of changes and accessibility on-line or on-demand. An example can be complex ads that are updated during broadcast and can elicit user response in real time, or a record of teachers' presentation accessible in the virtual university environment jointly with the synchronized slide show, which the student can interactively work with. Currently, there are several theories dealing with various aspects of the rich-media implementation, such as *Media Richness Theory* (Daft and Lengel, 1986), *Media Naturalness Theory* (Kock et al, 2008) and *Social Presence Theory* (Short, Williams and Christie, 1976).

MERLINGO project (*MEdia-rich Repository of LearnING Objects*) is designed for the management of the central repository of the learning objects based on the rich-media technologies accessible within the Czech national academic computer network CESNET2 (MERLINGO, 2016), for implementation of "barrier-free" information access of students to records of presentations of teachers on-line or on-demand, for upgrading teaching process mainly for combined and distance form of study, for dramatic cost reduction of operation of those technologies, for creating conditions for the establishment of collaboration with other universities and by achieving accessibility of the project results in the form of standard services.

MERLINGO project implementation was launched in 2007 and currently, services of its central repository of learning objects are integrated also with the services of the central LMS Moodle VSB-TU Ostrava virtual university platform. Several years of experience with making rich-media based records of presentations of teaching staff and their publishing has revealed many bottlenecks of commercially available technologies mainly involving:

- inaccessibility or difficult implementation of programming interface providing interaction with learning management systems of virtual universities,
- relatively high purchase price of individual recording systems and the necessity of annual payment for programming support to supplier,
- technical difficulties in realization of presentations of records in locations which are not equipped with a necessary infrastructure (camera and microphone systems, sound, mixing device, etc.) requiring relatively expensive and time consuming technical support,
- impossibility to outfit each teaching staff with their own mobile recording system that could be used for preparation and publishing of a lecture at times, when such staff is outside their work place, on business trips, conferences, etc.,
- limited mobility of existing recording systems (dimensions, weight, range of required accessories) including demands on technical knowledge and skills of teaching staff in case the person is to put the recording system in operation themselves,
- enabling easy editing and modifications (e.g. edition, post-production) of records of lectures which could be done by teaching staff without technical assistance and on a mobile device,
- programming systems used for recording of presentations do not have Czech localization.

The above listed bottlenecks of both applied technologies led to the development of the new programming product *EduArt* (EduArt, 2016), which was implemented by MERLINGO team of researchers cooperation with PolyMedia Technologies s.r.o. firm. In many aspects the issue of presentations recording is solved by a brand new technology based on rich-media.

*EduArt* (***Edu****cation* ***Art***) is a new progressive software product designed for working with the rich-media, realization of asynchronous communication and recordings and their publishing on-line or on-demand. As opposed to similar commercially available products, this programming system can be installed and used on any device (including mobile devices) using the *Microsoft Windows* operating system. *EduArt* software can record and synchronise video and audio (from camera and microphone) with a presentation shown on the screen of a given device (using any programming system for the presentation purposes, for example *MS PowerPoint*, or a visualizer, an electronic board, a tablet, and other devices connected to the computer with installed *EduArt* programming system via standard input interface) and at the same time it creates the metadata content of the presentation. There are synchronously recorded all the individual channels in their original distinction (i.e. audio, video, images and metadata) in the resulting output. This is how *EduArt* differs from other competitive rich-media products which record (compress) the whole presentation into one video channel. Individual images (slides) of the presentation are recorded in native resolution of the graphic card of applied computer and stored in JPG format. Next revolutionary feature of the *EduArt* system is the capability of scanning more displays of a given device. It means the teacher controls recording of the lesson on one primary display while he/she can display and control the results of the recording on the secondary display.

The resulting presentation recording can be then transmitted to the viewer/listener as a webcast (on-line) or as an on-demand recording that can be then accessed anytime, anywhere, in accordance with the end user's needs and available options. On-demand recordings of the presentations can be exported to a web server (Internet, Intranet) or stored on a variety of storage media (CD/DVD/BD, flash disks, external drives) and then used for the asynchronous communication purposes.

Records created using the *EduArt* programming system can be viewed/played on any computer or other device that uses a web browser. The viewer can play presentations in the sequence in which they were recorded or use the option to fast-forward or to replay as needed, using the video control or thumbnails of captured slides, thereby repeating a sequence or viewing only the sections that are interesting him or her. All the channels (video, slides and audio) continually remain synchronised. Also other metadata can be included in the presentation such as references/URL links, which take the viewer to other, related resources on the Internet (e.g. textbooks, biographies, manuals). *EduArt* programming system is also applied in the area of adaptation of rich-media learning objects for the students with special needs.

## 3. Practice with generation of tasks

The best way to understand statistics is doing the statistics (Snee, R., 1993). But in the first it is necessary gain the practice with some special statistical tasks.

For the creation of a large amount of tasks, it showed that the better way is combination of typesetting system TeX and statistical software R based on an idea of literate programming like systems *Sweave/knitr* using the *noweb* syntax for mixing a text and a code for a computation. Package *Exams* (Gruen, B. and Zeileis, A., 2009) offers a flexible environment for automatic generation of tasks in a wide range of output formats including PDF for printed version of tasks and XML format adapted for Moodle.

In our practice with generating sets of exercises we found a lot of difficulties and inconveniences. There are introduced some of them.

### 3.1 Precision and rounding problems

The results in statistical tasks are numbers, especially the real numbers with infinite decimal places. When this type of tasks is intended for computer aided homework/exams it is necessary to make a convention about a precision of decimal representation of numbers. There are some problems with this convention.

The first problem is a type of a rounding. The IEEE Standard "go to the even digit" for rounding a number 5 is mostly used in statistics and also in R software. It means that a number 5 is rounding to the nearest even number. On the other hand the secondary school mathematics courses (and also Microsoft Excel, for example) use the "rounding up" rule for a number 5.

There are two statistics courses at our university. The main software for computing in the first one is MS Excel. The students of the second one use the statistical software R. Different rules for rounding in results of exercises should be used in both groups.

In the group of rounding errors it can be placed errors in task assignments. For example, a task tests whether students are able to recognize between the binomial and the hypergeometric distribution. Task is: "A bag contains 5 white balls and 95 black balls, 4 balls are drawn." A difference between a probability of drawing any number of white balls with replacement and without replacement is less than 0.003 and then after the rounding to two decimal places we obtain the same results in both cases. Results rounded to two decimal places can't recognize that students use correct or wrong method to solve this exercise. But on the other hand, plenty of significant decimal places in results can lead to a rejection of correct result due to some accuracy error during a calculation.
Our experience is that rounding to the four significant digits, is the best way in the most cases. But students very often can't distinguish between rounding to four significant digits and rounding to four decimal places.

With rounding come problems of representation errors in computers. For example 0.15 in decimals has infinite periodic representation 0.00100110011… in binaries. In different operating systems the number 0.15 could have different rounding to the first decimal place (either 0.1 or 0.2). This type of rounding error can't be adjusted.

### 3.2 Problem of a correct type of results

When we create large numbers of tasks, we should focus on the aims of task. For example, we bring a case of task concerning to one sample $t$-test on significance level $\alpha$. If we randomly take the data from normally distributed population with parameters $\mu_0$ and $\sigma^2$ we obtain only $100\alpha\%$ of tasks which lead to rejection of a null hypothesis. But it might be good for the students practice, when one half of the exercises end with rejection of a null hypothesis and one half of the exercises end by a rejection of an alternative. In the process of creation of a task it can be achieved when we pick up the $p$-value (the result of a task) at first and and then we can make a data. The better way to make this data set is to choose a data set $w$ of sample size $n$ from normal distribution and standardize them using formula

$$z = \frac{w - \overline{w}}{\mathrm{sd}w},$$

where $\overline{w}$ is the mean and $\mathrm{sd}w$ is the standard deviation of data set $w$ and $z$ is the standardized value ($z$-score).

We obtain the data set $x$ whose mean is exactly equal 0 and the standard deviation is exactly 1. These data should be rescaled by multiplying by standard deviation $\sigma$ and shifted them to the new mean

$$\mu_0 \text{ plus (or minus) } t_{1-p/2}(n-1) \cdot \sigma/\sqrt{n},$$

where $t_{1-p/2}(n-1)$ is a $1-p/2$-quantile of the Student's distribution with $n-1$ degrees of freedom

$$x = z \cdot \sigma + \mu_0 + t_{1-p/2}(n-1) \cdot \sigma/\sqrt{n}$$

The final data set has the standard deviation equal $\sigma$ and the difference between mean $\overline{x}$ and the value $\mu_0$ is equal $t_{1-p/2}(n-1)/\sqrt{n}$ multiple of standard deviation $\sigma$. Thus, when we use the $t$-test for the final data set $x$, with null hypothesis $H_0$: $\mu = \mu_0$, we obtain a $p$-value just equal to our picked value $p$.

This process ensure, that we can predict a number of tasks which leads to rejection of a null hypothesis and/or number of task which result is rejection of an alternative. For another hypothesis testing it is possible to make analogous procedures.

### 3.3 Problems of grammar

In Czech language there is very complicated grammar. One of the problems is an inflection for counted nouns. In English there is no difference between spelling of expressions "2 balls", … , "4 balls", "5 balls", and so on. In Czech there aren't differences for counters 2–4: "2 koul**e**", …, "4 koul**e**", but for some counters greater than 4 there is another ending of the noun, for example "5 koulí" and so on. An ending of the noun depends on the counter and on the conjugation pattern of the noun. When we create a task with random sample of an input it is necessary to use a function which completes a principal part of a counted noun by an appropriate ending according to the counter and conjugation pattern of the noun.

## 4. Experience with practical application of new methods in e-learning

### 4.1 History of LMS Moodle at VSB - Technical University of Ostrava

At the Faculty of Economics VSB - Technical University of Ostrava (VSB - TUO) we have years of experience with using of e-learning. The first experimental Moodle installation was performed in 2003 at the Department of mathematical methods in economics, only two years after the publication of this e-learning system. A year later Moodle became the official e-learning platform at the Faculty of Economics. In the same year the first annual conference Moodle Moot was organized by our faculty in the Czech Republic. In 2012 LMS Moodle became the official e-learning platform at VSB-TUO as an integrated part of the university information system. Currently this LMS has more than 300 e-learning courses.

As the possibilities of LMS Moodle expand and the ability of teachers improves, the courses began to expand by interactive and feedback elements - forums, assignments, tests, etc.  A big qualitative leap was brought by Moodle version 2, which was installed in 2011 at the Faculty of Economics, VSB-TUO. Since then, the teachers have use multimedia learning support in their courses, such as audio or video recordings. Merlingo system for recording streaming media was described in chapter 1 of this article. The system is mainly used for making recording of lessons for combined forms of education, records of conferences performances organized by the faculty or university, or records of invited speakers and international experts. Selected recordings are available at merlingo.vsb.cz.

In 2015 a group of teachers from the Department of Mathematical Methods in Economics began to solve the problem of automatically generating tasks and tests using the R language and Exams library. This very useful tool was described in chapter 2, including some problems that had to be solved by authors. Its deployment allowed creating entirely new tools for testing and verification of student's knowledge in different subjects mainly of quantitative focus. The module Test, which is a standard part of commonly used e-learning environment LMS Moodle, is often used for creating tests and evaluation tools at schools. Unfortunately, this module is not very suitable for developing mathematical or statistical tests because it contains only a limited number of functions that can be used when creating quantitative tasks (for example, the important statistical functions, such as skewness, kurtosis, or quantiles, are missing). This new tool fully solves the lack of classical module Test in Moodle.

## 4.2 A new form of testing at LMS Moodle

The first subject, which was equipped with the new kind of tests, was the master course of statistics (named Statistics B) for the distance form of study. In this course the standard credit written test used for full-time form of study was replaced by ten examples that would be continuously solved by students in the environment of Microsoft Excel and then sent the results as XLS files through LMS Moodle to teacher. The authors of course had prepared several versions of each example that were randomly assigned to students at the beginning of the semester. This should make more difficult to copy solved examples among students, but this plan was not very successful and forced teachers to generate new and new versions of examples each academic year. Also the process of revision and grading the examples solutions was quite laborious. Because there usually about 150 to 200 students studying statistics each year it takes even more than 20 working hours to check a single example. Because students often surrendered their solutions at the last moment, the teachers had to check many examples at once and they usually did nothing else than reading and grading the examples solutions in the evenings. Yet students often complained that they had to wait a week or even longer for the results. It was obvious that such system of testing students' knowledge has been ineffective and had to be changed.

In the academic year 2015/16 all the classic credit examples in Statistics B were replaced by the new tasks generated automatically in LMS Moodle environment using Exams library in R. Each student gets different and completely original tasks. The individual tasks differ from each other not only in numbers (data), but also in the context and control questions. So the students are very likely to prevent from copying the solutions from each other. Students have to solve the tasks using any statistical computing environment (usually Excel, but also R or SPSS is available) and then fill out a form with questions. Each task contains several questions that require answers in the form of numbers, short text or to select one of the offered alternatives. Immediately after completing the form and sending it for check the task is automatically evaluated and the student receives immediate feedback. The feedback information consists not only of the points reached and list of right and wrong answers, but also of comments explaining the proper solution and warning of common mistakes.

The minimum number of points is set for each task that students must achieve. If some student does not reach this limit, he or she has to repeat the task. When repeating the task, a new context, data and individual control questions are generated. (Some students in an effort to improve their skills use the opportunity to repeat tasks, even if they fulfilled them. This is not a problem because only the highest number of points from the task is counted into the resulting assessment.) LMS Moodle allows even to set that some tasks would be available only if a student fulfil the previous tasks but this option was not used in Statistics B course.

Making automatically generated tasks required much more time in their preparation, but also debugging, compared to conventional examples. If tasks would have to spend their role, they must not only test and score the student's performance, but also give them useful information in the form of feedback, which mistakes they made and how to avoid them next time. Therefore, the teachers have to put themselves into the role of students and estimate what errors students can do and why. To create tasks in the Exams environment teachers must also know at least the basics of R language and also the basics of TeX (or LaTeX) mark-up language. This effort, which represents some hours of work during the holidays, is worthwhile. During the semester the teacher does not need to waste time checking dozens of examples, which is a stressful job, but he or she can focus on his or her other educational and scientific activities. This also eliminates the need to update the examples each year because the number of versions generated randomly is virtually unlimited.

## 4.3 The results of testing and student feedback

In the academic year 2015/16 a number of 178 students enrolled the subject Statistics B in distance form of study with a new form of testing knowledge using automatically generated tasks. A total of 93 students successfully completed the subject, representing approximately 52 % success rate. For comparison, Table 1 shows statistics of the three previous academic years, in which the classical examples were used for testing.

**Table 1**: The success rate of students enrolled statistics B subject

| Academic year | No. of students | Successfully completed | Success rate |
|---|---|---|---|
| 2012 / 13 | 204 | 101 | 49.5 % |
| 2013 / 14 | 138 | 77 | 55.8 % |
| 2014 / 15 | 182 | 89 | 48.9 % |
| 2015 / 16 | 178 | 93 | 52.2 % |

It is obvious that the success rate in the course Statistics B annually fluctuates around 50 %. However, we must objectively say that many students especially in distance form of study do not finish their first study year, so these low numbers are not caused only by the difficulty of Statistics B itself, but the by the overall underestimation of graduate studies complexity. Nevertheless this table shows that the success rate is relatively stable and has not changed even by changing the form of credit testing (from examples to randomly generated tasks). Table 2 provides a subjective evaluation of the Statistics B course by students. As rated attributes there were monitored: difficulty of the course, time - consumption, Moodle course and overall teaching quality. All attributes were evaluated on a scale from 1 to 5 and averaged. Students were asked to compare Statistics B with other study subjects, while mark 1 represents “significantly better”, mark 3 means “comparable” and mark 5 is “significantly worse” in comparison with other subjects.

**Table 2**: The student evaluation of statistics B subject

| Academic year | Difficulty | Time consuming | Moodle course | Teaching quality |
|---|---|---|---|---|
| 2012 / 13 | 4.62 | 4.68 | 1.52 | 2.32 |
| 2013 / 14 | 4.69 | 4.75 | 1.48 | 2.06 |
| 2014 / 15 | 4.53 | 4.70 | 1.58 | 2.46 |
| 2015 / 16 | 4.60 | 4.70 | 1.57 | 1.84 |

It is evident that the evaluation of difficulty, time - consumption and the Moodle course quality is comparable in all the years. Regarding to the difficulty and time - consumption, Statistics B has traditionally been viewed as one of the most difficult subjects. The relatively positive evaluation of the course enrolled in the LMS Moodle environment is gratifying, where students rank this course as one of the best at the faculty. Values of the last attribute, teaching quality, show that the overall education process of Statistics B subject is also evaluated as positive. In last year, 2015/16, the teaching quality average mark under 2.0 and it even approached the level of Moodle course evaluation. Whether this is also due to the new form of testing using randomly generated tasks that is friendly towards students with fast responses and feedback, the following years may indicate if these statistics continue to be monitored. Within the evaluation of the course students should also express their opinion on the usefulness of statistics for their further study and practice. Even in this case the range 1 to 5 was used, while mark 1 represents “very useful subject”, mark 3 means “comparable to other subjects” and mark 5 is “absolutely useless subject”. Students rated usefulness of statistics both at the start of the course, and again on the end of the term. The shift in their assessment during semester was monitored and the results are shown in Table 3.

**Table 3**: The shift in the perception of statistics as a useful subject

| Academic year | Before | After | Shift |
|---|---|---|---|
| 2012 / 13 | 2,84 | 2,48 | -0,36 |
| 2013 / 14 | 2,91 | 2,65 | -0,26 |
| 2014 / 15 | 2,76 | 2,37 | -0,39 |
| 2015 / 16 | 2,81 | 2,15 | -0,66 |

In all the years the students' view of the usefulness of statistics has changed in a positive direction during the semester. Pronounced shift in 2015/16 year (about two thirds of the stamp point) may be associated with a new form of testing student knowledge, however, we must wait at least two next academic years whether this positive trend will be confirmed or whether this is just a random fluctuation.

After becoming familiar with a new type of testing with use of automatically and randomly generated tasks several teachers from the department of mathematical methods in economics also decided to improve their subjects with new automatically generated tests. Currently, this option is also tested on a selected group of students of Statistics B course in full time form of study. It would be interesting to compare the results and attitudes of students who are studying Statistics B in classical form with 2 written tests and students who are fulfilling the set of 10 credit tasks in LMS Moodle.

## 5. Conclusion

LMS Moodle has become an important part of the university information system (InNET) at the VSB - Technical University of Ostrava as well as e-learning support has become a natural part of learning subjects not only in distance, but also in the full-time form of study. Standard built-in tools of e-learning system are enriched with new functions that are mediated by external technologies, both hardware and software in origin. Implementing these technologies allows the authors of the e-learning courses and the teachers to increase the quality of the educational process. Two new technologies were introduced in this article, which are used mainly at the Faculty of Economics. The MERLINGO Projects is a combination of hardware and software rich-media technologies which allows to carry out records of the educational process and to achieve their immediate access in LMS Moodle courses. The system of automatically generated tasks and tests using the R language and Exams library is mostly used at the Department of Mathematical Methods in Economics. Possibilities of both the projects are not fully utilized. The effort of this research for the future is primarily wider dissemination of these new technologies among the educators.

The authors also discuss the possible use of other innovative tools in the educational process. They already think about the novelties of the new version of Moodle 3.0, which would be implemented at the university in the academic year 2016/17. One of the new options is also the data connection between IS Edison (the part of the university information system for learning and teaching processes evidence) and LMS Moodle, which allows the transmission of the results of tasks and tests directly from Moodle into Edison.

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# Handling Knowledge Through the iPad: New Engagements in Learning

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**Abstract:** This paper aims to identify ways in which tablets as handheld technologies create personalized spaces that engage children in learning in new ways. Specific attention is given to the ways in which personalized learning spaces enabled by tablets are embodied through hand-eye-technology relationships, and through engagement with multiple interfaces such as screens (e.g. smartboards, pcs and mobile devices). Mobile technologies are closely bound up with our embodied engagement in the world, as mobile devices are carried and used in close and immediate proximity to our bodies and are navigated through touch. With the ubiquity of mobile technology uses in everyday practices the body-technology relation is increasingly becoming a fundamental ontological condition, as seeing, knowing and perceiving becomes mediated through personalized technologies. Handheld devices thus potentially provide users with dynamic ways of engaging in knowledge that are embodied and tactile. In schools handheld technologies generally follow learners in the dynamics created by spatial organizations of learning which include the placement of tables, chairs and artefacts within the learning space and the infrastructure of movement between them. Spatial organizations that involve mobile technologies such as tablets often contribute to positioning learners as users of technology and producers of knowledge. These personalized infrastructures of learning can be observed through research and understood as processes that shift with different learning aims, school subjects and tasks. Empirical examples in the paper are drawn from two recent research projects in which learning was studied ethnographically through observations and interviews in four lower secondary schools where students used tablets (iPads) as personal devices for learning. Classroom observations identified ways in which the iPads supported students in learning in personalized ways by providing increased bodily engagement in learning. Observations also identified ways in which knowledge was framed in multiple ways through learners' interactions with screens of different sizes.

**Keywords:** mobile learning, iPads, body-technology relationships

## 1. Introduction

Mobile technologies contribute to reconfiguring understandings of and engagements with spaces, for instance through the use of social media, location- and navigation technologies (Wilkin and Goggin 2012). Through personalized technologies that fit the hand and are easily carried and accessible, users can interact with spaces in new ways when they are on the move or settled in places and wish to connect to networks, knowledge or localities in which they are engaged but not necessarily physically present. Mobile devices thus increasingly participate in enacting spaces in new ways, where users can explore personalized and embodied engagements in the world (Meyer 2016). IPads are mobile devices which increasingly participate in students' activities with mobile devices in or out of schools. In formal learning spaces IPads are gaining ground as significant devices for engaging with knowledge in personalized and accessible ways. However, schools provide specific frameworks and practices for engaging with knowledge that affect how devices can be used. This includes organizations of spaces, forms of interaction and embodiment, and connections between multiple learning resources that are not only digital. The question is therefore how students can engage in learning with mobile devices within restricted spaces of learning, and how IPads contribute to redefining spaces for learning within these contexts. In the following I shall draw on empirical knowledge from two research projects to explore how IPads contribute to redefining students' spaces and embodiment in learning through new practices and epistemologies of learning. In the paper I focus on practices of handling knowledge through image capturing and eye-hand relationships in iPad usage.

## 2. Modes of engagements in learning – insights from the literature

In the context of this paper modes of engagement in learning can be understood as ways in which knowledge can be enacted within specific sociomaterial configurations, for instance spatial organisations and body-technology relationships (Fenwick, Edwards & Sawchuck 2011, Johri 2011). It is suggested that mobile technologies contribute to reconfiguring engagements in education, and that iPads in particular participate in modes of engagement that are personalized, situated and embodied (Burden 2012, Henderson & Yeow 2012).

Schools are significant social spaces in which different kinds of materials and practices define modes of engagement and learning. However schools are also to some extent restricted spaces in which practices are maintained and perpetuated over time (McGregor2004, Friesen 2011, Lawn & Grosvenor 2005, Meyer 2016).

According to McGregor (2004) and Lawn & Grosvenor (2005), spaces such as classrooms are relatively stable networks of objects and relationships that are embodied and materialized in specific ways. However, spaces such as classrooms are also continually changing, being reorganized and redefined through educational reforms and technological change, though some of these changes are more obvious than others (Johri 2011, Nespor 2011).

As aspect of how schools change is the way schools are increasingly bound up with new media such as smartphones and tablets (Cook et al 2011, Kukulska-Hulme 2009). Students' use of mobile technologies can for instance affect how spaces are experienced, imagined and practiced. Students can for instance enhance their mobility, personalize their learning and position themselves in new ways in the classroom by adapting the iPad to their current practices and needs (Burden 2012, Henderson & Yeow 2012). In schooling mobile devices therefore generally become meaningful within the social spaces that students inhabit in their everyday learning, where devices are drawn into the fabric of everyday activities.

A significant aspect of mobile learning within or outside schools is the body-technology relationship which enables us to see and act in spaces in novel ways. As suggested by Ek (2012) and others, mobile technologies are closely bound up with our embodied engagement in the world, as mobile devices are carried and used in close and immediate proximity to our bodies. Handheld devices thus provide users with dynamic ways of seeing that are embodied and tactile (Cooley 2004, Richardson 2010). With the ubiquity of mobile technology uses in everyday practices the body-technology relation is therefore increasingly becoming a fundamental ontological condition, as seeing, knowing and perceiving becomes mediated through body-technology relations. These engagements and ways of envisioning and capturing the world significantly alter spatial orientations and involvement through for instance hand-eye negotiations and body postures, as when mobile cameras are directed at specific foci of attention in the environment or even at the photographer him/herself in the ubiquitous 'Selfie'.

In classrooms screens of different sizes may be significantly involved in defining spaces and students' orientations within the learning space, for instance through smartboards or personal devices such as pcs. In schools mobile devices such as smartphones may not be as ubiquitously involved as they are in other social spaces, however, portable and personalized devices such as iPads are increasingly gaining access to schools and participating in learning (Meyer 2015a). According to Richardson (2010), windows, frames and screens increasingly affect our ways of seeing as an embodied activity, which influences the corporeal dynamics of social spaces. Technologies such as pcs and television screens have for instance affected our fundamental spatial orientations, as our relationship with these technologies are defined by a frontal ontology where faces and gazes are directed towards the interface of the screen. This ontology, Richardson argues, often turns out differently when mobile devices are involved, as the frontal orientation is compromised by the shifting positions of the body when using portable devices. Micromobility and shifting attention modes therefore define new spatial orientations and ways of engaging in the environment.

In classrooms, new mobilities and body- technology relationships are changing the ways in which seeing and knowing can be practiced, as students work through and on screens of different sizes that organize spaces in specific ways. These relationships potentially change the hegemonic spatial organisations of classrooms, however, knowledge is needed to understand exactly how these new relationships change spatial configurations and thereby learning. In the following, I shall investigate how shifting organisations and relationships between technologies affect the practices of learning and how the involvement of mobile technologies affects students' bodily engagement in different ways.

## 3. Data and methodologies

In this paper I draw on examples from two recent research projects in which learning with tablets was studied ethnographically through observations and interviews in four lower secondary schools where students used tablets (iPads) as personal devices for learning. In project A research focused on how the integration of iPads in teaching and learning could support inclusive educational settings in lower secondary schools. In the project inclusion was understood as a broad concept, i.e. with a focus on inclusive educational settings where all pupils are valuable and active participants in the learning community (Meyer 2015a). In this study five classes of 7$^{th}$ grade students (age 13-14) were followed over one school year (2012-13) through observations and interviews in schools. In project B research explored the role of multiple technologies in learning, including iPads, in three rural lower secondary schools (7-9th form, ages 13-15) where students and teachers had been working with a unique combination of iPads and stationary auditorium based screens for collaboration and learning through videoconferences (Meyer 2015b). Videoconferences were significant for these schools as they were all based in rural areas where cultural institutions, connections to others and local experts are scarce, and where video-based interactions can open up for new perspectives and resources in learning. Data were collected through multi-sited etnography, i.e through observations and interviews in several sites, for instance different kinds of learning spaces in the schools, including shared spaces. According to Marcus and others (Marcus 1995, Hannerz 2003), multi-sited ethnography has provided a methodological framework for ethnographically following things, ideas and people in global contexts where phenomena are mobile and transient.

I argue that data from these projects can be used in identifying ways in which iPads support students in learning in personalized ways by providing increased bodily engagement and spatial enactment in learning. Thus, I compare data from different research contexts in which students' production and interaction with knowledge was framed in different ways through shifting modes of engagement. I propose that following these multiple sites for investigation of iPads in schools can provide knowledge about how these technologies are implicated in personalizing learning.

## 4. Personalizing learning spaces through capturing and framing

When the student has access to his/her personal iPad as there are many potentials for movement and engagement, and for working with multiple modalities in learning. Gunther Kress (2010) argues that when mobile technologies are accessible to us and follow us, we have the potential of copying and storing information and combining material in new ways where it becomes less important to create something from scratch. Kress conceptualizes these practices as 'capturing', which means that as users we capture, reorganize and reconstruct information and knowledge through our smart device in our own ways. Frequently, this implies taking photos that we edit and include in new contexts and combinations. This is a new practice connected with mobile devices, where visual representations, i.e. photos and film, often replace or gain priority over written material.

In school the iPad is often used by students to take photos of information posted on or written by the teacher on the blackboard or smartboard where words, concepts, diagrams, tasks or web pages that the teacher has indicated are significant for the students' learning. This way of interacting with the teacher's information or knowledge often replaces the otherwise common practice of taking notes with a pen or pencil or writing in a word processing program on the student's pc, iPad or mobile device. When students use their iPad to take photos of information on the blackboard or smartboard they are able to both store, organize and work with knowledge generated from the teacher and integrate it into their own personal context. Typically, students will combine different kinds of resources in their learning, i.e. not only knowledge presented by the teacher, but also information from e.g. webpages and their personal folders. However, the iPad is an interesting tool in the student's work with a specific task as the tablet allows the student to create new links between the teacher's knowledge and domain in the classroom and his/her own work with the relevant knowledge on a personal platform. As a web 2.0 tool the iPad not only supports the student in collecting information but also in producing and transforming knowledge – for instance by remediating text into a visual product such as a photo or a film.

**Figure 1:** Capturing grammar in German (project B)

Capturing information with a tablet is thus not only a practical strategy which in some cases replaces the practice of taking notes, it is an active selection and framing of something, where the student uses his/her body in new ways in learning. The hands are in this context particularly significant, as students use their hands to direct the iPad at something, to focus their view on what is significant and in turn capture it. The student's view of what is significant in learning is therefore coordinated by the hand, in fact, it can be argued that seeing has become a handheld and tactile activity and that it is a coordinated hand-eye relationship (Cooley 2004, Meyer 2016). The hand thus contributes to creating vision and the handheld technology engages the body in new ways, where the student frequently has to move towards the artifact or information that he or she aims to capture, as it may not be possible to capture information from a sitting position. It is therefore not only the hand that moves the vision, but the entire body that is involved in an active attention to and framing of knowledge. This is a new spatial and embodied dynamic in the classroom that supports personalized engagements in learning within the relative inertia of classroom organization.

## 5. Micro-mobilities and new trajectories of learning (project A)

Capturing creates a new space for the student within the space of the classroom. Within this space the student can enact learning in various ways through the use of iPads and other kinds of resources. However, within this new dynamic of spatial enactment the student also typically moves and creates links and relationships between the sources of knowledge situated in the classroom. These sources can be digital or analogue and represent different kinds of modalities in the learning environment (Meyer 2015a).

In the photo below three girls are working to produce a poster in geography, where the topic is the solar system. The students are supposed to create a model of the solar system in which distances and scales of the solar system are presented accurately. Prior to the situation represented in the photo the teacher has directed the students' attention to a poster on the wall that illustrates distances between planets and the sun and other relevant information for the task at hand. In figure 2 below the girls are replicating the teacher's indication of the poster by pointing at it with their iPad and capturing the information on the poster.


**Figure 2:** Capturing the solar system

After the activity of capturing comes a process of developing and qualifying the work on the students' personal poster. This is done through internet searches on Google, where the representation of the solar system on the original poster is checked with other kinds of information and illustrations of the topic. The students also check their textbook where more knowledge on the subject can be found. Finally, the students use the image captured on the iPad to measure out and construct their own version of the solar system on the poster at their work desk. In this way they both transform and reappropriate the knowledge presented by the teacher into their own format and modality through capturing on the iPad. This is done by shifting the students' attention between the teacher's framing and his/her own framing of the material on the personalized screen. Within this personalized space the iPad can participate in productions of knowledge that are organized to suit the embodiment and visual framing of the student. As the iPad is flexible and follows the student, it can both, as seen in the photos, be placed in a stationary position and held in the hands of the student to be moved to other locations and positions where knowledge is displayed. Thus knowledge production in enacted through micro-movements between domains and resources in the classroom, where the iPad both supports the mobility of the student and shapes it in significant ways. Within this mobility engagement in learning is enacted in specific ways where the students produce knowledge through relationships and connections and through tactile vision that implicates the body in new ways.

**Figure 3:** Producing the poster

## 6. New forms of engagement: Epistemologies of the hand

The example shows how technology becomes implicated in the student's learning, how the student engages in learning and how the iPad contributes to creating a space around the pupil where the body is engaged in the learning in various ways. The iPad thus becomes part of the pupil's ad hoc engagement with the resources that are accessible to him/her in the immediate learning space and that are used to mediate and qualify the knowledge that the student is working with. However, there are also other aspects of the hand-eye connections in pupils' learning with iPads, as these mediate engagement and learning in specific ways. Svend Brinkmann and Lene Tangaard (2010) for instance argue, based on among other sources Dewey's pragmatism that there are alternatives to the "epistemology of the eye" that often defines western approaches to learning. This visual epistemology, Brinkmann and Tanggaard claim, generally favor a split between theoretical and practical knowledge as it is an approach to knowledge where knowledge is created through passive, theoretical contemplation, dividing those 'who know' from those who 'do not know' but only act in practice. Brinkmann and Tanggaard aim to transcend this division by arguing for an espistemology of the hand, i.e. an approach to knowledge that acknowledges that "people know different things and that everything we know…must have some connection with practical action" (2010, 245). In this practical engagement with knowledge the hand is engaged in interacting with and creating knowledge through the 'manipulation' of artefacts and phenomena in the world. In this approach to knowledge the hand simultaneously acts as a metaphor for the entire body which is constantly implicated in experiential engagement with things and problems in the world. As opposed to the epistemology of the eye, the hand therefore offers an embodied and temporal approach to knowledge, where artefacts and phenomena must be manipulated and engaged with in order to create learning. Significant in this context is also the fact that the eye in contemporary consumer society is constantly bombarded with information, impressions and invitations to engage, whereas engagement through the hand is a more paced process, where practical aspects of the world are constantly manipulated, if knowledge is to be gained. Consequently, engagement through the hand generally provides a temporal approach to learning, where the eye engages the learner's spatial understanding.

The argument for reconsidering learning and education in the context of an epistemology of the hand reaches into discussions of project based learning, creativity and aesthetic approaches to learning, however, it is specifically relevant for learning with the iPad, as this technology so clearly reactualizes the role of the hand and the body in learning, as the example shows. In the example it is however not only an epistemology of the eye that acts in learning, but relationships between the eye, the IPad and the hand that create a space for the student's engagement, knowledge and learning. It is therefore not feasible to maintain a division between hand-eye engagements in these examples of learning, it is rather, as Cooley (2004) argues, the relationship or 'fit' between the hand, the eye and the technology that creates the epistemological practice of viewing and learning.

In addition to this what is 'touched' and handled by the hand is not the artifact itself (for instance the poster), but the tablet, which contributes to capturing, storing, organizing and presenting knowledge in specific ways. What is at stake in the use of the iPad is therefore a more complex relationship than the one described by Brinkmann and Tanggaard, though knowing through the hand is still a very relevant approach to understanding the shifts in body-technology relationships that the IPad contributes to establishing. How this contributes to creating new modes of engagement in learning will be developed in the second example of the paper.

## 7. Embodiments in physics: Handling eye-hand-technology relationships (project B)

As mentioned above the iPad is an integrated tool in three schools in a rural municipality in Denmark, where students are also taught and collaborate through videoconferences. The following therefore describes how iPads and big screens were used in different ways in the teaching of physics, where the topic was metals. The example illustrates how the pupils were engaged in different ways in spatial organizations where technologies contributed to the learning.

In the photo below pupils in the 7$^{th}$ grade are about to start their lesson in physics, where the theme is metals. The pupils are lining up outside the videoconference room, which is not their home classroom and is situated in a different part of the building. In the room chairs and tables are placed around the big screen at one end of the room as in an auditorium, to enable everyone to see and hear pupils in the other local schools through the screen. The pupils can also see the PowerPoint presented by the teacher who is in charge of the lesson, and who is situated in a school about 20 kilometers away. The local teachers are also present to facilitate the teaching and ensure that students are focused on the task. The idea of the course is that the individual classes work individually with the topic after this first session and at the end of the course share their videos through telepresence.

The students are placed in telepresence rooms in their individual schools and view each other frontally through the big screens on the walls. Telepresence rooms in the schools are organized differently in the individual schools, for instance as already mentioned as an auditorium or as an ordinary classroom with chairs and tables in rows. However, all telepresence rooms are dominated by frontal views (Richardson 2010) directed at the screens on the walls. The organization of the learning spaces is therefore dominated by screens and the interaction framed by these screens, i.e seeing and listening from a relatively passive position, where learning is defined by an epistemology of the eye.

**Figure 4:** Telepresence in physics: Learning about metals

In the following lessons the students are spread out in their own classes in the individual schools. In one of the lessons that follow the telepresence activity the students learn about metals in the physics room where the teacher shows the students how to do an experiment and afterwards asks them to do the experiment themselves. During the session in the physics room and in the laboratory the students use their iPads as an active part of their learning and can direct their attention to different kinds of relevant knowledge in the learning spaces. In this process the students use their camera to capture and appropriate information and knowledge. In the photo below a female student is capturing the experiment with her iPad by positioning the tablet at an angle to allow for a close view of the experiment. Her attention is focused not only visually on the action but is a fully engaged bodily position that enables her to engage closely with the activity.

**Figure 5:** Filming the experiment through the iPad

The examples show how pupils work with a topic through shifting positions, screen sizes and modes of engagement. In the auditorium interaction and learning thus takes place primarily through the eye, i.e. the students observe (and listen to) a presentation from the teacher who disseminates information and knowledge about metals through the screen. The auditorium supports this organization of the teaching and learning, as chairs and tables are placed in a frontal position towards the screens. In this way the eye is drawn to and engaged in the screens that fill up the frontal wall of the room.

In the experimental practice in the laboratory, on the other hand, the iPad acquires a central role in the engagement in the learning activity, as the pupil recreates and records the experiment made earlier by the teacher in the adjacent classroom. Through the iPad the student engages in the task through a handheld vision, where a perspective is chosen, focused and held by the student and supported by a fully engaged bodily involvement. This handheld vision represents a new way of engaging with and producing knowledge where the tablet is a significant actor in the activity and where the student emerges as a user and learner through hand-eye-technology relationships. The hand-eye-technology relationship thereby significantly shapes the epistemology of learning.

## 8. Implications and some conclusions

Handheld technologies such as the IPad provide students with new possibilities for engaging in learning. This is connected to increased mobilities in the classroom and to new relationships between technologies and other learning resources. Seeing through and on the screen is a ubiquitous activity in the schools observed, where screens are both fitted to classroom walls and placed close to students' bodies and work spaces. These shifts in interactions with technologies participate in creating spaces in which students are placed and learning embodied in specific ways. IPads in particular take part in creating dynamic spaces in students' learning, as IPads are continually involved in what students do and how they choose to frame, fit, see and save material that they are currently working with.

Large stationary screens, on the contrary, generally invite frontal orientations in which students face the interface chosen by the teacher and in which teachers' framings of information and knowledge often prevail. However, large screens can also be linked to students' devices, such as iPads, as when a film or presentation is shared in the telepresence room. The dynamic of these links is to transport material from the personal space of the student to a shared space in a different part of the school, where the activity is focused on showing, sharing or viewing material on the large screen.

As illustrated by the examples above, a significant principle for an organization of learning that includes the iPad is therefore proximity and in particular the embodied or tactile seeing that is connected with the tablet which enables students to combine corporeal proximity with cognition and understanding. This is an engagement in learning which incorporates the student's body in new ways, as well as integrates a more extended part of the student's immediate surroundings and personal perspective in the learning. These potentials for student centered learning reconceptualize spatial enactments of schooling through enhanced body-screen relationships.

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# Computers and Multimedia in the Situation of Language and Cultural Diversity

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**Abstract**: The proposed paper focuses on the issue of developing and supplementing teaching mathematics in linguistically and culturally heterogeneous classrooms using computers and multimedia. The issue of how to support teachers who face the reality of having to teach in a setting where the mother tongue of some learners is not the language of instruction has recently attracted a lot of attention due to the fact that EU countries have to face an increasing flood of migrants. The authors ask if and how the use of computer technologies and multimedia might help in preparation and individualization of teaching materials suitable for use in linguistically and culturally heterogeneous environment, i.e. when both teachers and learners have to cope with a situation when language and culture may be an obstacle to learning and teaching mathematics. The authors demonstrate that meaningful and appropriate use of computer technologies and multimedia may significantly support preparation of teaching materials and their use in lessons. The authors discuss different uses of ICT proposed in the different teaching units developed by members of the project team M3EaL – Multiculturalism, Migration, Mathematics Education and actually used in piloting in 6 European countries (France, Italy, Austria, Norway, Greece, the Czech Republic). They discuss their potential for development of both mathematical competence and communication skills in the language of instruction. The paper also shows the potential of ICT as the source of materials that can supplement traditional printed materials that do not reflect the specific needs of migrant pupils. Examples of concrete didactical units are shown and discussed. The developed materials illustrate the rich potential of the use of computers and multimedia materials both by teachers and pupils. Each of the developed units was piloted by three project partners. Each of the piloting teachers adapted the proposed material to meet the conditions of their own classroom. And it was the process of adapting and piloting the materials that showed the rich variety of possible uses of ICT both while planning and while conducting the lessons. The experience of implementation of these units into lessons also confirm the enormous motivational potential of the prepared teaching units.

**Keywords:** multicultural environment at school, language diversity, cultural diversity, use of computers and multimedia materials, mathematics teaching

## 1. Introduction

One of the very hot contemporary topics in education across Europe is the growing cultural heterogeneity in society and in consequence also in classrooms. This puts new demands on teachers who have to learn a new situation of facing groups of children who are no longer from the same linguistic and cultural backgrounds. Contemporary employers are looking for employees with diverse cognitive and affective skills referred to as the 21st century skills that include: the ability to communicate with people from different cultures, use a wide range of technologies, solve complex problems, think critically, cooperate, adapt to the rapidly changing society and conditions for fulfilling their tasks, fulfil work duties efficiently, and independently find and gain new knowledge and information (Rotherham, Willingham, 2010). In other words, the ability to live and cooperate in linguistically and culturally heterogeneous settings is one of the so called 21st century skills. Culturally and linguistically diverse classrooms are on the one hand an environment in which communication among people from different cultures takes place naturally and on everyday basis, i.e. a situation similar to what pupils may expect in all their future lives and careers, on the other hand it represents an additional load on the teacher, lesson planning and classroom management. Thus what we have to focus on is how to teach these classrooms efficiently, for the benefit of all (Moraová, Novotná, 2015; Moraová, 2015).

As a result the issue of teaching in culturally and linguistically heterogeneous classrooms has attracted growing attention of policy makers, researchers and teaching public (e.g. Lerman, 2010). One of the projects focusing on this issue is the EU project *M$^3$EaL – Multiculturalism, Migration, Mathematics Education* (526333-LLP-1-2012-1-IT-COMENIUS-CMP), whose objective was analysis of the situation of cultural and linguistic diversity in mathematics classrooms in 6 European countries, detection of the needs of in-service teachers who face this situation and development of teaching materials suitable for work in these classrooms. (Moraová, Novotná, Favilli, 2015) The needs of in-service mathematics teachers from six European countries were mapped using a questionnaire survey (Ulovec et al., 2013), which clearly showed that majority of teachers see computers and use of ICT as one of the cornerstones. They speak of use of CLIL websites, dictionaries and glossaries, materials in minority languages that are essential when teaching in a classroom like this. The question one has to ask then is what resources are really useful and how should they be used efficiently? Many authors warn of the missed opportunities when using ICT in mathematics lessons (Robová, Vondrová, 2015) or about "for show" use of it (Jančařík, Novotná, 2011). The team members, aware of this danger, proposed several teaching units later piloted in diverse schools in the six countries with different age levels. In these teaching units, the authors proposed some use of computers and multimedia but the piloting teachers then adapted the proposed methods and use of ICT to fit the needs of their classrooms, schools and teaching styles.

The paper presents a summary of the teaching units, use of ICT and multimedia proposed in the units but also actually used by piloting teachers. The research question we ask is how authors of mathematics teaching unit work with the use of ICT in the lessons and also to analyse the practices of teachers across Europe when working with the proposed material. We also try to look for the reason why practices in the use of ICT differ.

## 2. Theoretical background

This paper builds on three research areas: the issue of the use of computers and ICT in mathematics classrooms, issue of linguistic and cultural diversity in mathematics classroom and development of teaching units easily adaptable to particular classrooms (substantial learning environments). The reason for this multifocal theoretical background is that the authors of the paper want to look at how to construct materials that make good use of computer technology in a setting of cultural and linguistic diversity and are at the same time flexible enough to be easily adapted to the needs of different classrooms across Europe. The authors also want to show where the use of computer technology in a mathematical classroom turned out to be counterproductive.

### 2.1 Teaching in culturally and linguistically heterogeneous classrooms

Until recently, much less attention has been paid to cultural and linguistic diversity in different subjects. Although there was a relatively large amount of research relating to multiculturalism, most of it has covered teaching 'in general' without really making a distinction between subjects; some research centred on difficulties in relation to the teaching of a particular subject and, moreover, it mainly covered teaching of language or natural sciences (McDermott, 1974, 1977; McDermott & Varenne, 1995); research on mathematics teaching is rarer. Much of this research focuses on adjusting the curriculum to the cultural backgrounds of the pupils with a view to rendering teaching more effective. The following question is usually asked: Is the teaching of mathematics less sensitive to cultural differences? One recent exception shows a new approach to research on mathematics in multicultural classes (Norén, 2010).

It is generally accepted (e.g. Barton, Barwell and Setati, 2007; Bishop, 1988; César and Favilli, 2005; Favilli, Oliveras and César, 2003) that mathematics teachers feel the necessity for training and materials which reflect the needs of their classes in terms of linguistic and cultural differences. Their pupils from minority cultures and/or those with a migrant background encounter even more difficulties than their native classmates in acquiring fundamental mathematics skills. Learning a new language and culture at the same time as you learn mathematics places additional burden and challenges on immigrant pupils (Norén, 2010).

The question is how to develop materials that will at the same time reflect the needs of minority pupils, teachers and at the same time will be flexible enough to be usable in classrooms across Europe, when teaching different classrooms with children of different age, skills and with different educational, socioeconomic, sociocultural and linguistic backgrounds. The answer (and the piloting of materials developed within the frame of the M3EAL project confirms this) is to develop materials in the so called substantial learning environments.

### 2.2 Substantial learning environments, problem posing

The concept of substantial learning environments – SLE was developed by Erich Wittmann (1995). According to Wittmann's definition an SLE is: "A good teaching material for teachers and pupils should be the one which has a simple starting point, and a lot of possible investigation or extension."

Application of this Wittman's concept made project teams from partner countries look for settings and starting points that would allow teachers and learners from different cultural backgrounds form different types of schools, levels, skills and abilities, to find mathematical material appropriate for their mathematics and way of doing mathematics. Each teaching unit developed within the project proposes such an environment (ornaments, magic squares, famous mathematicians, finger multiplication, triangles etc.) and sketches more possible ways of making use of the environment. It is always stated explicitly or implied that the potential is much wider and the scope of using the material limitless. And it is confirmed in the following pilotings in different countries with very different learners. The only must is that the teachers be creative and have the skill of problem posing.

Undoubtedly problem posing is an important component of mathematics curriculum, and is considered to be an essential part of mathematical doing (NCTM, 2000; Tichá, Hošpesová, 2010). It is an activity every teacher of mathematics does almost on everyday basis. Teachers pose problems when they need to supplement problems provided by the textbook. And it is exactly the area where the teacher, if given the right impulse, may pose problems allowing pupils with different cultural or linguistic backgrounds to succeed and to excel.

If we take into account the outcomes of the above mentioned questionnaire survey, many teachers can be expected to use ICT when making adaptations and when posing problems in these diversity supporting substantial learning environments. This implies enough attention must be paid to how computers and ICT are used for these ends. As we will show in the following part, not every use of communication technology turned out to be beneficial in piloting of the developed materials.

### 2.3 Use of computers in mathematics classrooms in theory

It can no longer be doubted that computers, communication technology and multimedia have entered our private lives, jobs and also schools and education. As stated in (Jančařík, Novotná, 2011), researchers pay due attention to use of ICT on primary and secondary school levels and in pre-service teacher training. Computers in mathematics lessons have become a tool of motivation, a tool for individualization and differentiation, a tool for discovery and conceptualization etc. They also foster comprehensible interdisciplinary links between mathematics and other subjects.

It comes as no surprise that in the questionnaire survey mentioned in 1. Introduction (for details see Ulovec et al., 2013) in-service teachers regard computers and ICT as indispensable when planning and conducting lessons for culturally and linguistically diverse classrooms – as a source of learning materials, for translation into mother tongues of minority pupils, to make the lessons more individualised and learner-centred.

However, it must be born in mind that the use of computers in teaching asks for new approaches both to explanatory stages of the lessons, to stages in which learners practice and to classroom management in general. If a teacher decides to be using technology in their classroom, they must conduct a very careful a priori analysis (Brousseau, 1997) of how the use of technology actually develops learning and contributes to meeting lesson objectives. Computers and multimedia should support, help, develop thinking and support understanding, they should not just entertain. All this in the situation of the immense diversity of ICT resources, which often leaves the teachers unsure of which to use, as well as when and how to use them (Jančařík, Novotná, 2011). Most teachers still are not digital natives and might struggle to use technology to its full potential.

## 3. Materials and methods

The authors of this paper analyse several teaching units developed within the frame of *M³EaL – Multiculturalism, Migration, Mathematics Education* project (http://m3eal.dm.unipi.it/index.php/en/teaching-materials) and how these units were piloted with respect to how ICT was planned to be used by the authors of the units and actually used by in-service teachers who were piloting the units. The methods used in this study were the following: analysis of teaching unit focusing on how the potential of ICT is used to make the unit efficient, observations from pilotings of the units, analysis of video recordings from the pilotings, interviews with the teachers. The teachers who were piloting the units were asked how they felt using ICT, whether they found the way ICT was used efficient and whether they would make any changes if they were to teach the same unit again.

## 4. Results and discussion

In this section the authors provide findings from their analyses and from interviews with the piloting teachers. They show examples of different uses of information technology proposed in the teaching units developed for multicultural and multilingual classes. As will be demonstrated, technology was used both by the authors of the teaching units when developing them but also by the piloting teachers and sometimes the proposed use and actual use are in contrast. Analysis of how teachers pilot the units gave the authors a deeper insight into the issue of what role ICT plays in creation and use of teaching materials designed for culturally and linguistically heterogeneous classrooms. As piloting teachers stated in post-piloting interviews and as the project partners who had been observing the lessons both stated ICT was very helpful with respect to allowing the teachers to make full use of the so called substantial learning environments (Wittmann, 1995). The tool for evaluation of piloting was observation of lessons and analysis of video recordings as well as post-piloting interviews with the piloting teachers.

## 4.1 Austrian unit

The Austrian team develop a unit focusing on Famous mathematicians and important discoveries in mathematics. The design was developed primarily for upper secondary pupils; younger pupils are not likely to understand the mathematics that is to be presented. The objective of the teaching unit is to draw attention to the fact that every culture in the world has contributed somehow to developments in the field of mathematics. It wants to raise learners' awareness of richness of the world heritage and to increase every learner's pride in their own culture and home country.

Already in the proposal of the unit, pupils were expected to be using computers and information technology: for the one thing as a rich source of information about the mathematician/discovery, as the tool for making a presentation for the rest of the class.

The unit was piloted in three different settings. The main piloting was conducted in an Austrian upper secondary school, the second and third pilotings in two Norwegian schools and in Greece in Special Juvenile Detention Centre of Volos with young detainees from all classes of Junior High School.

The first piloting more or less followed the unit as it was proposed. Pupils were working in small groups, doing internet research and synthesising the information into a presentation in a form they preferred. Having being given the chance to select the format of presentation, half of the students preferred a PowerPoint presentation, while another preferred paper hand-made posters (see Figure 1).


**Figure 1:** Examples of students´ presentations (Austria)

In the follow-up interview the teacher remarked that PowerPoint was just a mode of presentation with no additional value and thus she not only did not find its use indispensable, on the contrary she encouraged use of pen and paper as more creative.

Similar conclusions were reached by teachers piloting in Norway. The final presentation of discoveries made was a timeline created out of paper posters developed by different pupils (see Figure 2). However, use of computers when searching information seemed to be essential.

Greek piloting under very special circumstances of a detention centre, however showed, that the teaching unit may be conducted (with difficulty) even without ICT in the classroom. Due to the prohibition of internet use by students inside the detention centre, the teacher undertook the search for information but his search was based on keywords provided by the student. Having been divided into 4 groups, each group gave instructions and keywords, which were going to be used to do the search. Moreover, the teacher was looking for materials in the mother tongue of the students (Romanian, Albanian, Pakistanis, Arabic). Based on the instructions of the students, the teacher searched and stored webpages containing the relevant information in the mother tongue of the students. Each group chose the information they thought was useful, the material was printed out and distributed to the members of the group, so that they could study it and record what they would put in the poster they would make. In the interview the teacher assessed the activity as very useful despite the fact that the search could not have been carried out by the students. Although the search was not, the information processing was and thus the students not only had the chance to learn more about their home country and work in their mother tongue, they were also processing a lot of information, choosing and interpreting what was relevant and thus developing culture awareness as well as higher order thinking skills.

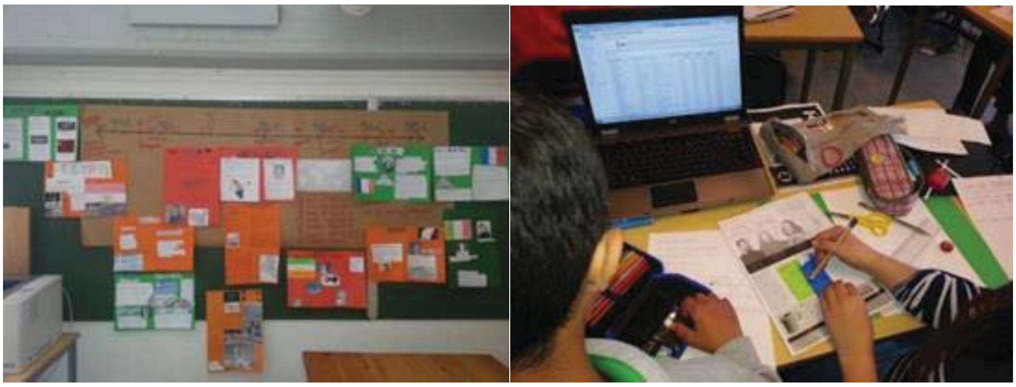

**Figure 2:** Examples of students´ presentations (Norway)

## 4.2 Sienna unit

Sienna unit entitled Factory of Triangles was focusing on independent discovery, group work and collaboration and development of mathematical concepts as well as mathematical language in culturally and linguistically diverse environments. The original teaching unit was developed with very little support of ICT. The discovery was based on manipulation with geometrical Meccano" – a kit consisting of rods of different colours and lengths (made of plastic, wood or metal) with holes at their ends or equally spaced holes along them. Use of IT was included and used in the first piloting in Italy in the form of internet browsing in a PC lab. Pupils were divided into small groups and under the teacher's guidance asked to search for websites on the internet related to triangles. The results downloaded included daily uses and applications of triangles (arrows' ends, tools …), the first buildings (tents and bungalows), architectural structures (roofing technology, trellis building, network beams …), maps (buildings, flats, cities, lands …) and works of art and architecture.

In the second piloting in the Czech Republic the teacher decided to replace internet browsing by using mobile phones. The school where the piloting was conducted has very strict rules about mobile phones. All pupils must turn them off when entering the building and can turn them on only when leaving it. For the purpose of study of triangles, the pupils were asked to turn on their mobile phones and use them for taking photographs of all triangular shapes they can find in the building. In this case mobile devices turned out to be a very powerful tool. A boring activity turned out into an exciting quest and the pupils discovered triangles in the most unusual places including the toilets. The pictures taken were then collected and projected for everybody to see. Several misconceptions of what a triangle is were also detected and corrected (see e.g. Figure 3 c). The teacher in the interview said she did not like the idea that use of ICT means browsing the internet. ICT offers much more than google search. (See Figure 3)


a) b) c)

**Figure 3:** Examples of collected pictures. c) a misconception of what a triangle is

The third piloting was done in France and built on the idea of internet search – this time the pupils were searching for flags with triangular shapes.

### 4.3 Greek unit

The Greek unit proposes a unit called "Putting bins in our School yard". It is a task based activity which at the same time develops on development of communication and team collaboration through work on a common project based on real-world task and allows pupils to discover mathematics – drawing maps, scale, angles. As the unit was proposed pupils (the expected target group were 6th or 7th graders) were asked to measure the school yard, draw its plan and propose where to put bins in such a way that all pupils in the school yard find it easy to dispose of their garbage when they are out. For the implementation of the above, students were expected to use space notions, measuring, similarity, proportion etc., as well as to use prepositions such as down, up, above, and to communicate verbally and/or in other modes their ideas and their own ways of acting mathematically and to negotiate their reasoning socially, that is in the group, in the entire class, when addressing a formal agent, using different register and multimodal ways.

Most of the work was done without computers, using pen, paper and measuring tools such as colourful plastic rods. The drawn plans were scanned and projected to the whole class giving their authors the opportunity to explain their solving procedure. This activity was followed by drawing an exact plan of the school yard using the dynamic software GeoGebra. As the Greek teacher who was piloting the unit in the Greek school concluded, the use of dynamic GeoGebra added a dynamic dimension to the drawing of the schoolyard and gave the students the possibility to experiment with placing the bins. It also showed them the limitations of the previous framework, where the students drew the schoolyard using tactile materials.

The second piloting in a lower secondary school of Florence also involved use of GeoGebra for construction of the plan. The students of the two classes had never used a software of dynamic geometry before so they were put in a new work context. They made use just of basic rules of "GeoGebra", shown by the teacher, and were able to apply them to draw the official map. As a first level of application, the work was made on the square grid screen, i.e. a reduced use of the software with respect to its real potentiality. The problem is that the use of square grid facilitates the work too much time it leaves the substantial problem of setting a relation among lengths unsolved. As the teacher in the interview remarked, she is convinced the activity would have been more efficient if it were done only on blank sheet of paper as it would more likely result in grasping the concept of length, scales and ratio.

The third piloting was conducted in Pisa without use of ICT. Still, there were two pupils who did the drawing of the map at home used GeoGebra and another software ("planner 5d") for it. In the interview the teacher found it just another of the many possible ways of drawing a map and made no difference between paper and pen and software.

The Austrian team piloted the unit with upper secondary school students and were using GeoGebra from the very start seeing it as the most natural method for construction of a plan.

In case of this unit, the teachers' opinion on the use of ICT differ considerably. The most reserved and critical is the Florence teacher who is convinced GeoGebra facilitates the task to such an extent when pupils learn less than is expected.

### 4.4 French unit

The last of the analysed units to be presented in this paper is the French unit entitled Magic squares. The unit was developed with the aim of having students work at the same time on decimal numeration and on the use of the French language (language of instruction) in writing and speaking in mathematics both in terms of vocabulary and in terms of explaining one's reasoning.

In the first step according to the unit developed and as conducted in the first piloting, students used the collaborative software Frampad (www.frampad.org) to discuss and to discover what is behind the magic number 15 (Figure 4). Again, this expect some google search by the pupils but also online communication about what everybody discovered, which is a new dimension to mere browsing.

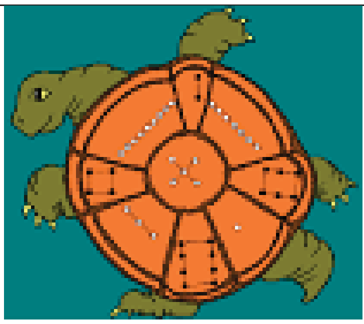

**Figure 4:** The Lo Shu turtle

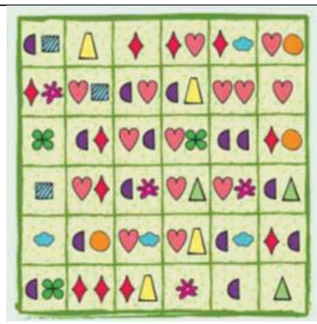

**Figure 5:** Special magic square

At the second stage the pupils were shown a special magic square was developed for this unit (Figure 5). Pupils' task was to decipher the meaning of this magic square and then to write a summary of their discovery using Frampad (www.frampad.org), i.e. a collective mission in which everybody is welcome to contribute and to modify classmates' statements (see Figure 6).

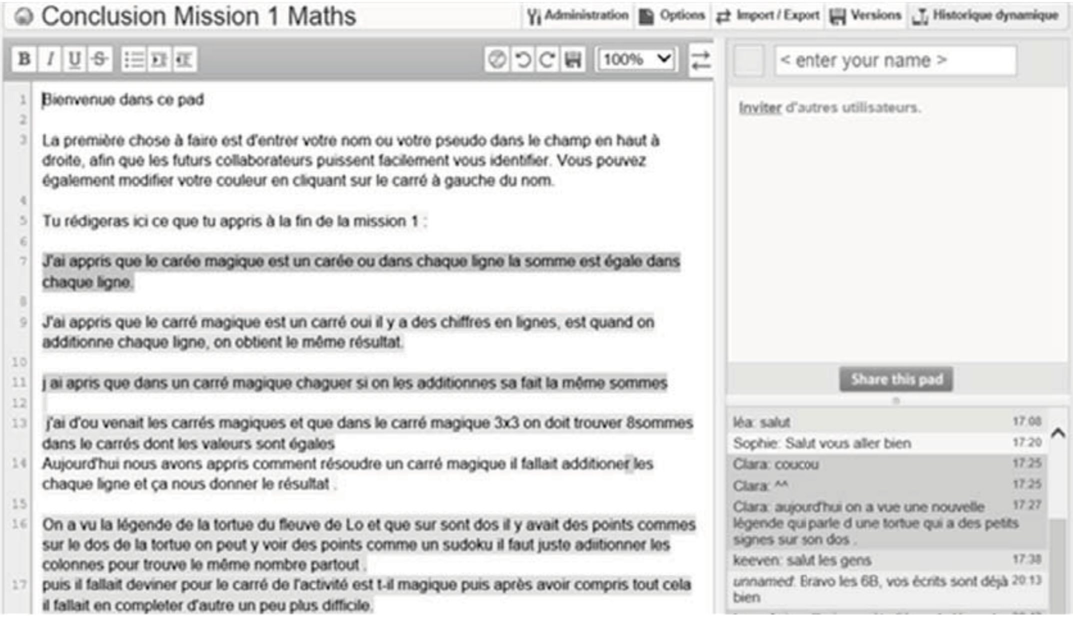


**Figure 6:** Pupils' online discussion

Some students reread and corrected mistakes in sentences that had already been written by others (change of colour in the line).

The second and third piloting in Italy and the Czech Republic could not make use of the collaborative software. In Italy it was because of management restriction in the PC lab. In this case this resulted in mere internet search for the meaning of Lo Shu pattern without sharing the findings online. This does not mean not sharing the findings orally but the innovative part of the French unit was lost anyway. In the Czech Republic the piloting did not take place in a PC lab but a regular classroom with a smartboard. The decision of the teacher was to omit the part with internet search. Instead, the Lo Shu pattern was projected on the smartboard and pupils could write over it to look not for what is behind number fifteen, but to look for the magic number itself, looking for patterns and regularities as well as explanations. With a little help from the teacher the pupils were able to discover the magic number and no internet search was needed.

## 5. Conclusions

The experience from the project shows that ICT is used very often when dealing with cultural and linguistic heterogeneity. In some cases the question is whether ICT was used for development in mathematics. It seems that some teachers see the use of ICT in classrooms as "Browse and find on the Internet". While in case of looking for information about famous mathematicians and mathematics discoveries use of information resources is essential, the Factory of Triangles is more important for its manipulation with the construction kit and individual discovery of the principle of triangle inequality regardless of the language a pupil speaks than for google search of websites focusing on triangles or flags.

According to one of the piloting teachers, the Greek unit of planning where to place bins in the school yard turned out to work better without GeoGebra, using pen and a blank sheet of paper and rods. On the other hand, the French unit when piloted in France made full use of the potential of the collaborative tool Frampad allowing pupils to collaborate online while solving a mystery, develop their collaboration as well as language skills. Still, as this tool was not available to teachers in other countries, they were able to pilot the teaching unit Magic squares without this online tool and their pupils still found it interesting and entertaining.

There is no doubt the use of ICT makes teachers' work easier. It is a rich source of information and materials. Still, a lot of work still remains to be done in the area of mathematics education to make in-service teachers aware of the difference between "for show" and efficient use of computers and multimedia in their lessons. ICT is an opportunity, not a binding law. And this holds equally in the situation of teaching a culturally and linguistically heterogeneous group of learners.

## 6. Acknowledgements

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# Cultural Content of Mathematics Word Problems in Online Electronic Materials

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**Abstract:** The paper presents an analysis of non-mathematical content of online teaching materials for mathematics created by Czech in-service mathematics teachers posted on the website www.veskole.cz that serves Czech teaching public as a source of interactive materials to be used on smartboards. It builds on a poster presented on ECEL 2015 conference. The question the author asks is how innovative electronic materials are as far as their cultural, non-mathematical content is concerned? Are these materials a mere conversion of traditional hardcopy textbooks or have its authors gone further, introducing new motives, images and realities closer to everyday lives of their own pupils and of themselves? The author of this paper builds on her research in the area of non-mathematical content of mathematics textbooks (Moraová, 2013) and of problems posed by teacher trainees (Moraová, 2014). This research tries to analyse what images of everydayness pupils come across in lessons of mathematics, in the process of which they absorb cultural norms very often unaware as their attention is focused on solving a problem. The presented research combines qualitative and quantitative approaches. The author analyses one hundred and seventeen activities developed for smartboards downloaded from the website www.veskole.cz. Word problems are classified according to their cultural content and the most frequent images are described and commented upon. The analysis clearly shows that Czech authors of inline materials fail to grasp the chance of introducing new topics and backgrounds and tend to use the most traditional word problems, only making them interactive. This is rather disappointing as the online environment and no intervention from external evaluators should be a very favourable place for innovation of the non-mathematical aspects. The findings of this study are of interest to in-service mathematics teachers planning to develop an online teaching unit, developers of online teaching materials in general, mathematics educators but also policy makers as not much attention is paid to the cultural contents of mathematics teaching materials.

**Keywords:** electronic materials, word problems, non-mathematical content, stereotypes, construction of social reality, stereotypes

## 1. Introduction

Contemporary world is a fast changing world in all aspects of our lives. This puts more pressure on school as an institution and teachers to adapt to the fast changes. One of the changes in today's society is the growing cultural heterogeneity of our society and classrooms. It is growing more and more difficulty to define what is the norm, what ways of life should be seen as "correct" or desirable. The teachers often face the reality of culturally heterogeneous classrooms whose pupils have very different experience from their own. And still, they should be able to teach such lessons that will be meaningful and useful for all pupils in their classroom. This is very difficult unless teachers have at hand teaching materials that reflect the changes in society, are more open and tolerant to otherness and actually speak openly of other cultural patterns and experience.

Sociologists, anthropologists and educators often draw attention to the fact that school is an institution responsible for reproduction of cultural patterns of a society and norms of everyday life. While functionalists, e.g. Durkheim or Parson (Prokop, 2005) see the process of enculturation as an important process that helps to maintain functioning of our society and believe that transmission of cultural values at schools is for benefit of all, theorists of culture reproduction and transmission as well as critical educators point out that this reproduction is for the benefit of some groups in the society while silencing and handicapping all other groups (Bourdieu, 1998; Apple, Au, Gandin, 2009; Giroux, 1983).

Critical educators are convinced that cultural transmission is not a static process and teachers' role in this process is not passive. In this perspective teachers are expected not only to mechanically transmit the official cultural values but to amend them, modify them, comment on them and work with them dynamically (Giroux, 1983). This subversive activity could be happening in situations when teachers stop using official printed textbook and become creators of their teaching materials. Non-mathematical, cultural content of word problems published in Czech hard copy textbooks of mathematics tends to be very conservative and stereotypical (Moraová, 2013). The newly published electronic learning materials created by in-service teachers should have the potential of presenting mathematics in a new way and in more up-to-date contexts. While printed textbooks often come out of their precursors, electronic materials created by in-service teachers may be based on classroom reality, on needs and interests of contemporary children, both as far as mathematical but also cultural content is concerned. And this is the case of the platform www.veskole.cz, a platform where in-service teachers upload materials for smartboards created by themselves. When creating interactive online materials, teachers can use their ideas and change the contexts and of presenting mathematics into contexts comprehensible and natural for their pupils.

Very often, innovation at schools is linked to the potential of modern technologies and electronic learning environments (Lagrange et al, 2003). If this is to be true with respect to cultural patterns and contexts, the online and electronic materials would have to present more open and heterogeneous contexts than traditional hard copy materials. But is that really true?

## 2. Theoretical background

The impact of mathematics textbooks and other learning materials on mathematics education must always be born in mind and has raised a lot of attention of mathematics educators. As Rezat and Straesser (2012) point out what happens in a lesson of mathematics can never be sufficiently described by the traditional concept of the didactical triangle 'teacher-pupil-mathematics'. There are a number of other factors that structure a mathematics lesson (artifacts, culture, community). Rezat and Straesser redefine the classical notion of the didactical triangle to the more complex and plastic model of a socio-didactical tetrahedron, which depicts the situation in a mathematics lesson much more accurately (see Figure 1). Artefacts used within a lesson (i.e. textbooks and also problems posed by teachers) are one of the factors affecting the course of a mathematics lesson and mathematics education in general.

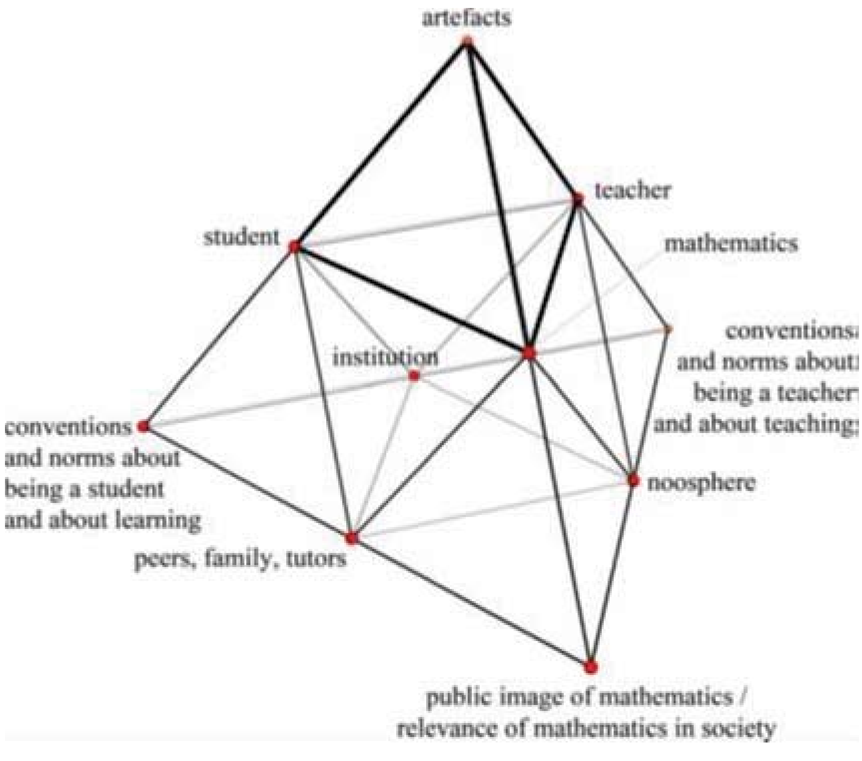


**Figure 1:** Sociodidactical tetrahedron according to Rezat and Straesser (2012)

As Havelková (2013) warns if schooling does not keep up with society pupils regard education as irrelevant to their lives. Meany and Lange (2013) take a different perspective and warn that learners who have to transit from one cultural context to another (home context and school context) are more likely to fail to be able to use their everyday knowledge of mathematics from home at school when doing mathematics. Thus they face an additional obstacle. Havelková (2013) suggests that introduction of modern technologies into classroom practices is one of the ways of making experiences from the outside world and from school closer to each other. But if this is to hold, modern technologies and online materials would have to be offering new contexts closer to everyday experience of learners. That is why the author of this paper has decided to make an inquiry into electronic materials produced by in-service teachers, posted in a website for Czech in-service teachers to see what cultural contexts are used in these materials and whether they tend to be more innovative and less stereotypical than contexts of Czech hard copy mathematics textbooks.

One of the objections that may arise is that the point of making a word problem if mathematics is to practice some mathematical concept or procedure, solving strategy or skill. It is natural that authors of mathematics textbooks and learning texts always put mathematics core and concepts first and adapt real life settings to their needs. The same happens in fiction. Literary theorists inform of the impossibility to depict "reality" and of every text being a mere *simulacrum* (Baudrillard, 1998). No text can ever be taken as a simple mirror of reality. However, the non-mathematical, cultural content of mathematical tasks and problems must never be ignored or seen as unimportant. A good setting of a word problem not only makes the problem more motivating and appealing and makes transition between contexts easier (and thus makes learning meaningful and allows pupils to use their everyday experience), but also every setting leaves imprints on pupils' mental schemas and their understanding of what norm and deviation are in a particular society. This is so because these categories are socially constructed. Textbooks and other learning texts including electronic materials make pupils define norm and otherness (Blackman, Walkerdine, 2001). Word problems are a literary genre *sui generis.* A word problem is in a way an extremely short story. It is a microcosm inhabited by characters who do something and solve "everyday" life problems for whose solution they need some mathematical procedure and algorithm. Word problems are meant to present real life, real mathematics and usefulness of it in real life. Thus the process of word problem posing closely resembles the process of conceiving the microcosm of a novel. The world and characters are merely fictional and only pretend to "represent" the real world and reality. However, reading is performative and if pupils meet the same images of the norm repeatedly, they consciously start taking them as the norm. This is the reason why any author of mathematics learning and teaching materials should very carefully construct the world their mathematics inhabits.

The here presented study builds on a study with pre-service teachers (Moraová, 2014). In this study the author of this paper conducted analysis of problems posed by future teachers to see how innovative or stereotypical they would be with respect to the non-mathematical content of problems they pose. The author wanted to see whether the "new" generation of teachers would try to use other contexts for their word problems than generation of their parents and teachers. The results showed that in the situation of posing a word problem, future teachers prefer to follow models they know from schools and textbooks and in contrast to Giroux's conviction that teachers do not only transmit official cultural values but modify them does not hold for future teachers of mathematics.

The area of multimedia is an area that could be seen as provoking innovation. The question the author of this paper asks in this study is: are in-service teachers, developers of multimedia teaching materials less stereotypical when selecting the contexts of their mathematics problems? Or do they tend to convert traditional texts into multimedia form without any changes to the content?

## 3. Materials and methods

The here presented research combines qualitative and quantitative designs. The author analyses about one hundred online activities that involve word problems. The analysed word problems are classified according to their cultural content and the most frequent images are described and commented upon. The categories into which problems are classified were developed in the course of analysis with respect to the cultural topics that could be come across. Whenever a new setting occurred, a new category was created. If the problem could be put into an already existing category, it was put there.

All the activities were downloaded from and are available at the website www.veskole.cz, which at this point provides about 35 000 teaching units for all school levels in all subjects and areas. It allows users to filter the content setting the subject (mathematics, elementary science, languages etc.), the age level (preschool, primary, lower secondary, upper secondary, other) and the planned use of the material (interactive exercise, materials for planning lessons). This limits the number of available activities and materials. Many of the materials allow the users to view them online and all of them can be downloaded for free. They are in notebook format and work on computers with SmartNotebook software (which is very common in Czech schools). The user can also see the number of downloads of the material. The materials are ordered from those that are evaluated by mark 1* to those marked 3 (the worst evaluation). This evaluation is done by users themselves and should give teachers some basic idea of the quality of the teaching material available. Considering the number of resources these marks may be very helpful to teachers to be able to predict the quality of a teaching material without having to download it. (see Fig. 2)

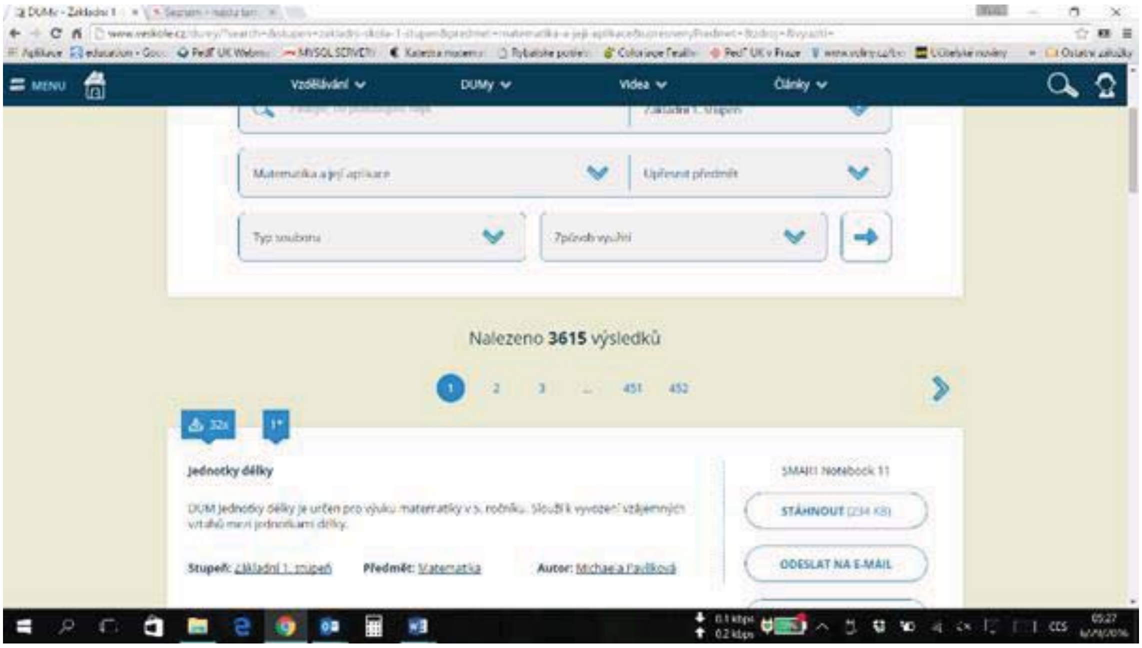


**Figure 2:** Printscreen of menu of www.veskole.cz

There is also a field in which the specific topic may be typewritten, e.g. word problems, fractions, area etc. to make the search more focused and the results fewer and closer to the desired mathematical content, concept, procedure to be taught, learned and practiced. For the purpose of this study the author used the key words word problems to limit the number of materials for analysis. These keywords show 195 results on primary school level. Primary school level was selected because the younger the children the more likely they are to read texts without critically assessing the content and thus are more likely to be affected and influenced by the contents.

Out of these 195 materials, the author downloaded 60 materials and conducted analysis of word problems that they include. She was looking for the setting of these stories, classified it to categories. These categories are introduced in the section below and commented upon. They are also compared to the findings from a study on setting of word problems posed by teacher trainees (Moraová, 2014). This should show whether there are categories of settings or motives that are not typical for problems posed in pen and paper.

## 4. Results and discussion

On average, each of the materials included 2.7 word problems. The total was 162 word problems. A material, despite being found as the result of search for word problems very often has several interactive exercises that are not word problems and have no story and also parts with explanations of new concepts. These sections are often followed by two to four word problems.

The first thing that the analysis shows is that typical characters of a multimedia material are white, middle class, from nuclear families. There are mothers and fathers, grandmothers and grandfathers. There are no word problems that would present divorced families or minorities. Everything tends to be middle class and white. The settings are most likely to be food (52%), money and shopping (10%), school (7%), animals (6%), hobbies and free time activities (6%). The animal world is a context that was not used by teacher trainees at all in the former study, otherwise, the settings seem to be very similar. Within the categories it holds that women and girls cook, buy or distribute food. If men or boys are mentioned in this context, they consume the food. If women go shopping, it is for food or clothes, fabric and shoes. If men go shopping, they buy books, wood, wire netting, nails. Sweets are most often distributed or divided by mothers and grandmothers. On the other hand, word problems in the category sports, hobbies and DIY are male dominated. DIY category is a special type of category which very likely has roots in textbooks from the 1970s and 1980s when families used to spend weekends at weekend houses maintained by fathers' manual work – building, decorating, repairing roofs, building a fence around the garden. This is an example of a category that builds in cultural settings from the past but does not represent contemporary reality when these activities are more likely to be done by hired craftsmen. Similar conclusions were drawn from analysis of problems posed by teacher trainees. This may not be surprising because in-service teachers who create multimedia teaching materials were brought on the same cultural contexts of mathematics word problems as teacher trainees involved in the study.

Multimedia teaching materials do not use the setting of the world of technology, which is very surprising taking into consideration that they build on use of these devices. Even here no innovation can be observed.

However, there were some differences to be observed between the non-mathematical contents. Out of the 162 problems, the largest group has the setting of food, eating it, buying it or preparing it (52%, see Figure 3). In problems posed by teacher trainees this was 61% (see Figure 4). A brand new setting of word problems in multimedia materials is the animal world. This is very likely to be connected to the facility of using pictures in colour, making the problems more attractive. When posing a problem in pen and pencil, the authors are not likely to use any illustrations and the world of animals loses its charms. Also, more attention is paid to the world of money and shopping in multimedia materials (10%) than in those posed by teacher trainees in pen and pencil (3%).

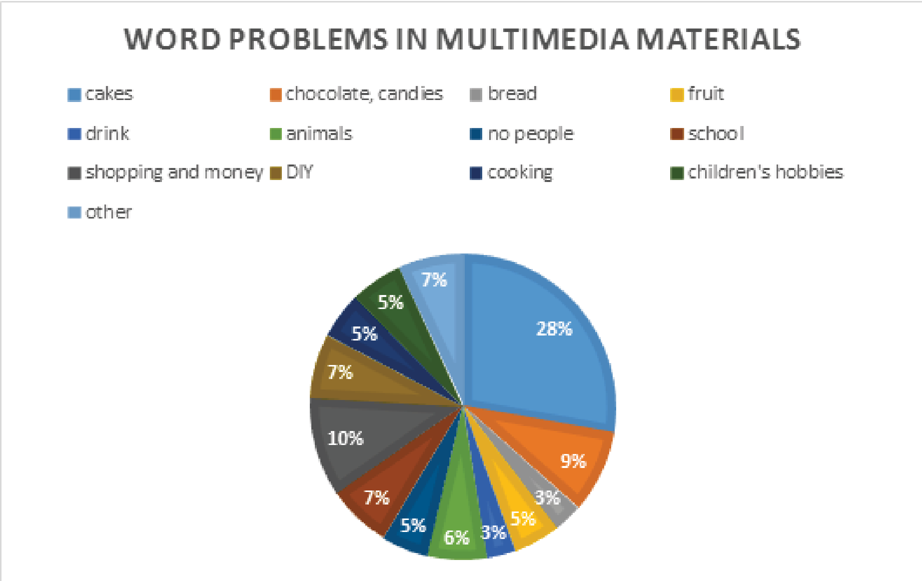


**Figure 3:** Proportion of word problems in different categories – problems from multimedia materials

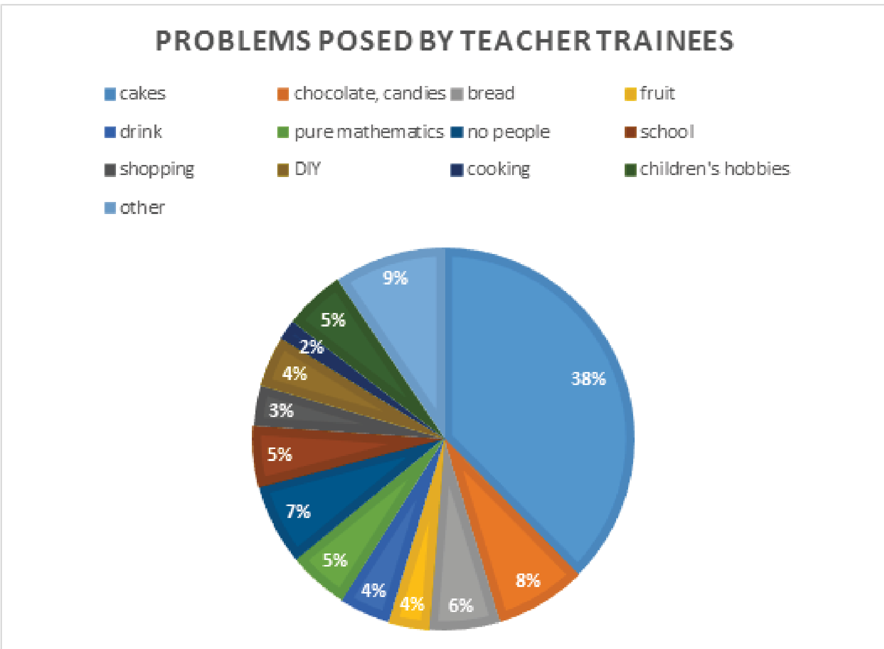


**Figure 4:** Proportion of word problems in different categories – problems posed by teacher trainees

## 5. Conclusions

The conducted study shows that despite critical educators' trust in subversiveness of in-service teachers who are not just automatons presenting materials and their cultural values but actively adapting them to current society and its actual state, the world they create in their multimedia materials is very stereotypical, far from real life and defending old-fashioned middle-class values, traditions. They fail to respond to the world as it is now.

The question that needs further research is why teachers prefer to pose these very stereotypical problems. Is it their belief that doing mathematics means doing it in a way and in the settings that were typical for their school years? Or is it their belief that young children should be brought up on extremely traditional values to make them "better" people? This would provide a broader view of the issue.

There is no doubt that more attention should be paid to the issue in teacher training to make mathematics teacher more aware of the influence a "literary" text in mathematics may exert upon pupils' thinking and values.

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# ePortfolios for Entrepreneurs / ePortafolios para Emprendadoras: Design and Development of an Online Distance Course

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**Abstract:** Supporting entrepreneurship is a frequently used strategy to fight unemployment in Europe as well as in Latin America. New established entrepreneurs in the diaspora often have difficulties to present themselves, their ideas and Curriculum vitae to reach an international audience. One idea for global and affordable presentations is to provide entrepreneurs with tools for ePortfolio construction online on the World Wide Web. English has always been the main language on the web but several studies indicate that problematic learning involving technical activities better is carried out in learners' mother tongue. This study is based on a secondment in the DiasporaLink project where an online course for ePortfolio construction has been designed and implemented in a collaboration between the Stockholm University in Sweden and the University of Development/Universidad Del Desarollo in Santiago de Chile. Two fundamental design concepts for the course are multimodality and bilingualism with Spanish as a complement for more technical sections of the course. The research question that the study aims to answer is: What are important factors in the design of an online course aiming to facilitate for entrepreneurs that want to construct and publish their own ePortfolios? The overall framework for the study has been a Design science setup with three phases where the aim has been to design, implement and evaluate an online course on ePortfolio construction with the use of HTML5 and jQuery. In the first phase design ideas have been gathered from a literature study before the second phase where the actual implementation was carried out. The final evaluation has been conducted in two iterations with the first evaluation done by a small focus group and the second by a NGO supporting unemployed female entrepreneurs. Findings show that both multimodality and bilingualism are promising design concepts for online courses. The first concept is rather easy to implement with new affordable recording options and an abundance of multimedia resources available on the net. The second concept of bilingualism is harder to implement and optimise since different target groups have different levels of English skills. Ideal would be to have everything doubled in all languages but with the problem of a more time consuming and expensive course development. Finally, the handshake procedure is, as always, crucial for an online course where user's first impressions of slow response times and complicated login procedures seem to scare off presumptive course participants without earlier experience of distance education.

**Keywords:** ePortfolios, multimodality, bilingualism, entrepreneurs, online education

## 1. Introduction

In the 21st century the number of diaspora groups who have left their home countries in search of better economic and political environments have increased. An indentified way to support diaspora groups is by the use of Information and Communication Technologies (ICT) and digital online platforms (Ding, 2007; Grossman, 2010). However, ICT alone is not enough to improve their living standards, it must be combined with sound governmental policies and an environments that fosters entrepreneurship and innovation (Grossman, 2010).

Entrepreneurship is a frequently used strategy to fight unemployment in many parts of the world, but new or unestablished entrepreneurs in the diaspora often have difficulties to present themselves and their ideas to reach an international audience. The European Union (EU) funded *DiaporaLink Project* was started to investigate how diaspora groups can be supported by a web portal and what strategies might facilitate transnational diaspora entrepreneurship (DiaporaLink Project, 2016). Using ICT to support people in the diaspora has been tried earlier in EU projects with a successful result (Diminescu et al., 2009; Borkert, Cingolani & Premazzi, 2009).

Today many persons in the diaspora have good English skills, but when it comes to more technical descriptions most people have easier to understand if instructions are given in their native language (Pierce & Robisco, 2010). This study that is based on an evaluation of an online course built as a secondment in the DiasporaLink Project will, among other things, describe and discuss the idea of using the multilingual Codecademy platform as an interactive tutorial for participants learning about topics such as HTML5, CSS and jQuery (Codecademy, 2016). Several of Codecademy's interactive online courses on programming and markup languages have been translated to French, Spanish and Portuguese (TNW News, 2014).

### 1.1 Research question

The main question to answer in this study is: What are important factors in the design of an online course aiming to facilitate for entrepreneurs that want to construct and publish their own ePortfolios?

## 2. Extended background

As part of a secondment in the DiasporaLink Project the course *ePortfolios for Entrepreneurs* / *ePortafolios para Emprendedoras* was designed, implemented and evaluated during November 2016. The course is developed for a global Spanish speaking audience with all course activities in online distance mode (DiasporaLink eLearning Portal, 2016). Four essential course concepts are multimodality, multilinguality, interactive online tutorials and the constructionist idea of entrepreneurs constructing their own web based ePortfolios.

### 2.1 Multimodality

Multimodality is briefly about involving several modes concurrently in instruction and communication. A mode has been defined by Kress (2009) as a channel of communication that is recognised in a culture. Within the field of multimodality, media/interface could be books, computers, radio and TV and with the use of sign systems such as words, images, sounds, fonts and colours (Allwood, 2008). The idea of multimodality has got a renaissance in the new technology enhanced Internet environments since people there are able to use multiple modes in their every-day interactions (Kress, 2009).

In traditional pedagogy and didactics Bloom's taxonomy (1965) has been a frequently used hierarchy of the cognitive-learning levels ranging from the root memorising level to the more advanced levels of applying, analysing and creating. Below in Figure 1 below an updated, internet enhanced and more multimodal taxonomy is depicted.


**Figure 1**: Bloom's Internet enhanced multimodal taxonomy https://ccr733.wikispaces.com/Multimodality

### 2.2 Multilinguality and mother tongue

Several research studies indicate that it is important for young children to use of their mother tongue to learn effectively (Cummins, 2001; Ball, 2010). When children have the opportunity to learn things in their native language, the probability to succeed in educational activities will be higher (Kosonen, 2005). There are examples of a crucial issues in course design such as the description of technical activities when adults learn more effectively if they get instructions in their mother-tongue (Pierce & Robisco, 2010).

An example of problematic learning with technical descriptions are teaching and learning of programming languages and markup languages. As found in a study by Pillay & Jugoo (2005) course participants with a first language that is different from the one used in the instructional design did not perform as well as the rest of the course group. Two ways of addressing this in educational contexts with technical sections is either to design everything in students' mother tongue (Souya et al., 1991) or to choose a more complex and time-consuming multilingual design (Yeum et al., 2007).

### 2.3 Codecademy

Codecademy a free online environment that provides interactive programming courses. The portal was created by Zach Sims and Ryan Bubinski to facilitate the learning of programming and markup languages. They had themselves became frustrated by the difficult inception level when learning to program, which made them investigate new ways for learning to code. Their conclusion is that the problem of learning to code through books or videos is that there is a lack of reward after the book is read or the video is watched. For that reason the learners in Codecademy's interactive tutorials get points after completed sections to motivate to continue to further sections (Vincent, 2011).

Everyone who joins a Codecademy course will be provided their own profile in the platform. User feedback is available and a built-in feature that keeps track of each user's total score and total daily streaks. Learner's scores and daily streaks are also displayed to other users. Courses are built with difficulty progression, but the user also has the option to choose which section to work with at a certain time.

Coding is learnt through watching, testing and creating program code, with the intention that the course participants really understand what the actual result of the coding will be. To help solving the given tasks hints, Q&A-forum and direct feedback are provided in the online environments.

Furthermore, progress bars shows how much of a course that is completed to increase the motivation to complete the remaining activities. (Högberg, 2015) After completing all exercises a badge is obtained. Moreover, there are online fora where learners can discuss and help each other regardless of their skill level. (Codecademy, 2015)

### 2.4 ePortfolios

In a broad definition ePortfolios can be defined as a digitised collection of artefacts combined with descriptions of the artefacts. Another definition is that ePortfolios are web based collections of work including the author's reflections over the construction of the artefacts (Lorenzo & Ittelson, 2005). As pointed out by Hartnell-Young & Morriss (1999) ePortfolios might have at least three purposes:

- Application portfolios for employment
- Tools for formative and summative assessment
- Learning systems for professional development

From a teacher and course developer's perspective they can also be useful for course evaluation (Lorenzo, G., & Ittelson, 2005). The importance of choosing appropriate ePortfolio systems has been widely discussed in research (Wilhelm et al., 2006; Meeus et al., 2006). Some researchers recommend free and open source systems (Brown et al, 2007) others licensed software (Strudler & Wetzel, 2005) and there are also ePortfolios integrated in virtual learning environments (Queirós et al., 2011).

The more constructionist approach is to let course participants design and build their own ePortfolios as a course assignment and as a part of learning a mark-up language (Mozelius, 2013). There are examples when students have extended wikis and blogs (Chen et al., 2005) or used developing tools such as Dreamweaver (Chang et al., 2011) but in a course where HTML5 skills is a learning objective the idea of constructing the ePortfolios from scratch can be part of the learning activities (Mozelius, 2013). In the course ePortfolios for Entrepreneurs / ePortafolios para Emprendedoras designing and implementing an ePortfolio is part of all teaching and learning sessions.

## 3. Method

This study was conducted with a Design science framework with three phases for the development of an online course on construction of ePortfolios. The first phase consisted of the specification of requirements based on a literature review. In the second phase the course was implemented as an instance in the Moodle virtual learning environment. Finally, the course was evaluated in two iterations by the use of focus groups. The first focus group was formed with students and teachers at the University of Development/Universidad Del Desarollo in Santiago de Chile and the second consisted of staff from a second by a Chilean NGO providing education for unemployed female entrepreneurs.

Design science is a research strategy to solve problems by developing artefacts. The delivery from a Design science project should by definition be a useful artefact that addresses a real world problem (Hevner et al., 2004). Design science has its origin in engineering (Simon, 1996) and is a problem-solving discipline where artefacts iteratively and incrementally constructed. Design science has later divided into various branches with the same root but with slight variations where this study has been carried out with the Design science framework defined by Johannesson and Perjons (2014).

## 4. ePortfolios for entrepreneurs / ePortafolios para emprendadoras

The course was developed as part of a secondment in the EU funded *DiasporaLink project.* A project with the overall objective of facilitating entrepreneurship for persons in the diaspora. Design, implementation and evaluation has been carried out as a collaboration between the Department of computer and systems sciences at Stockholm University in Sweden and the Department of Business and economics at the University of Development/Universidad Del Desarollo in Santiago de Chile. The target group are Spanish speaking entrepreneurs in the diaspora with basic to average English skills.

### 4.1 Course design

As earlier described in the extended background the initial design idea was to create the course with the four fundamental pillars of multimodality, multilinguality, interactivity and constructionism. Multimodality should not only be used in the instructional design but also as a general idea in students' activities and assignments. Today's ePortfolios should better be built with use of the rich flora of new internet modes that are depicted in Figure 1. Therefore, the use of images, videos, sound, colours and fonts is integrated parts of course content as well as of assignments.

Constructionism is student-centred approach with an emphasis on *discovery learning* where students should be encouraged to work with tangible objects and use their prior knowledge to gain further knowledge. An overall purpose is to visualise the process of learning and thinking and to engage students in a process-oriented setup involving construction and deconstruction. Teachers are supposed to give lectures or instructions in the traditional way, but rather being in the background taking the role as facilitators (Alimisis & Kynigos, 2009).

Learning should be achieved by tinkering with or constructing an entities and objects, with construction seen as an iterative activity and with design as a part of the construction process (Alimisis & Kynigos, 2009). A frequently used constructionist method is problem-based learning with the idea that students learn about a subject if they are exposed to multiple and increasingly complex problems. The well-known constructionist Seymour Papert has a vision that math students should live and construct their knowledge in *Mathland* (Cole, 2014) in the same way as students learn French from daily activities by living in France. For this course authors hope that enrolled entrepreneurs will spend as much time in the virtual learning environments as it takes to construct an ePortfolio that they feel proud of when the course is completed.

### 4.2 Course implementation

All course content and activities have been collected and structured as an online course in the Moodle virtual learning environment at the DiasporaLink eLearning Portal (2016). Online resources in English and Spanish have been complemented by code examples and recorded tutorials developed by the authors. Some material are truly bilingual but the majority of tutorials and videos are doubled with an English version and a Spanish version. One reason for the rich use of Codecademy resources are the fact that their tutorials on HTML5, CSS and jQuery always have Spanish versions, another is that their tutorials are well-designed.

Code examples are given in HTML5, CSS and jQuery to provide the building blocks learners need to construct their own ePortfolios. This is done in a block by block modularisation with the idea to break down the complexity of an ePortfolio and build it stepwise. Videos are all recorded with the Camtasia Studio software where the free 30 day trial version was used during the secondment in Chile in November 2015. There were also discussions on using the Articulate Engage software and for that reason their blog post on 'Five Ways to Engage Learners in Online Training' was read on the same day it was published (Articulate Engage, 2015). Three of their five ways of engaging online learners were used immediately in the implementation checklist:

- Engage Learners with Relevant Content
- Engage Learners with Interactive Content
- Engage Learners with the Look and Feel

All principles might seem to state the obvious but we found it anyhow valuable to include them in the checklist since the course had to be implemented quite rapidly.

## 4.3 Course evaluation

The first evaluation in Chile was carried out in two iterations with the first evaluation done by a small focus group at the university in Santiago and the second by two organisations supporting unemployed female entrepreneurs in Chile.

**Focus group evaluation**: The first identified bottleneck was the slow response time from the DiasporaLink eLearning Portal. This has later been addressed by donating the remaining funding for the secondment to an upgrading of the server where the course platform runs. A second 'handshake issue' was the relatively complex login procedure and our analysis is that what works for university students with good ICT skills might not work for entrepreneurs in the diaspora. A request for a completely open course without any registration or enrolment was sent to the server administration. These discovered issues made us return to the 'Five Ways to Engage Learners in Online Training' blog post to reconsider the two remaining ways of engagement:

- Engage Learners with Free Navigation
- Engage Learners with Just-in-Time Delivery

Free navigation is an important principle and we added to the checklist that we should keep all content open 24/7 with a navigation as free as possible. To facilitate navigation we also decided to rephrase the section instruction and make them more straightforward and clear. Once more, what works for students at a Swedish university might not work that smoothly for entrepreneurs in the diaspora. Another finding was that the level of English skills have greater variations at a university in Chile than what is the case at a Swedish university.

Regarding the fifth way to engage learners the idea of Just-in-Time Delivery did not seem suitable for this course where one fundamental idea is to have all content in place 24/7. This is built on the fact that different course participants have different study patterns and not with the same study pace since the presumptive course participant probably will not have the opportunity of full-time studies. The part of the Just-in-Time Delivery concept that was chosen for the course was the idea of breaking up the course into micro-learning modules or *coursels* (course morsels) like it is depicted in Figure 2 below. An idea that is quite close to the earlier decision of block by block modulisation of content and activities.


**Figure 2**: Course morsels as coursels

**Entrepreneur organisations evaluation:** Two earlier findings that appeared more obvious here are the importance of speeding up the server and that the level of English often decrease drastically. The managers of the organisations had good English skills but that do not go for all members and subgroups. Only one subgroup called *The Tech Girls* seemed to have the appropriate prerequisites in English and ICT to be able to work independently with the course. The common decision was to give access to all content to the organisations but with the idea of study groups including a facilitator. There were discussions on common workshops but it was hard to find common time-slots due to the Chilean summer/Christmas leave.

## 5. Conclusion

Multimodality and bilingualism both seem to be promising design concepts for online courses. Firstly, with new affordable recording options and an abundance of open source multimedia resources on the web multimodality is rather easy to achieve even with the design idea of overloading content in various modalities. Multimodality that add value should also be combined with the concepts of usability and high quality graphics while audio quality does not seem to be that critical.

Secondly, the concept of bilingualism is harder to implement and optimise and with a broader audience, as in this study, the different target groups have different levels of English skills. The bilingual mix that worked at university level in Chile did not seem to work for entrepreneurs with less English skills. The idea doubling everything in both languages seems tempting and a way to facilitate learning, but also time consuming and expensive.

Considering the engagement principles the three ones with relevant content, interaction and the importance of look and feel all seems like key issues. In case of a language barrier the usability is even more important. The concept of free navigation is also user-friendly and worth implementing while the idea of just-in-time delivery do not seem to be relevant in this kind of course design.

Finally, the handshake procedure is, as pointed out in several studies earlier, crucial for an online courses (Simpson, 2004; Mozelius, Collin, & Olsson, 2015). User's first impressions often last and slow response times and complicated login procedures risk to scare off new course participants without earlier experience of distance education and the same goes for unclear instructions violating learners' overview and control.

## 6. Future work

The fact that the course design mostly seemed to work only for participants with experience of tertiary education was disappointing. To find out if this is a mere language issue or if something else might be wrong with the course the course will be offered to unemployed Swedish entrepreneurs to evaluate the English course track. To address the issue with the slow server response in the login procedure the remaining funding for the secondment in Chile has been donated to improve the server performance which soon will be implemented.

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# Effectiveness of Note-Taking Instruction on Student's Reflections Upon Their Learning Activity During a Blended Learning Course

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**Abstract:** The metrics of self efficacy and self assessment were surveyed in order to examine the emotional changes of participants during a blended learning course. Two sets of questionnaires were developed to measure the degree of student's self-efficacy, and to facilitate self evaluation. Participants were surveyed twice during the course, using the metrics mentioned above, and their emotional and cognitive changes were evaluated. The number of valid participants was 54. Scores of metrics between the two surveys were compared. Though most scores for self-efficacy and self assessment decreased, this suggests that participants recognised their actual learning situation well. To illustrate participant's emotional and cognitive changes, causal analysis was introduced. The relationships between scores for self-efficacy and self evaluation in the two surveys were analysed and compared. Also, the impact of improvements in note-taking skills on changes in self-efficacy and self-evaluation were examined using causal analyses. These results show that note-taking activities significantly stimulated the level of self-efficacy and self-assessment when the lecturer's instructions were able to improve note-taking skills factor scores during the course.

**Keywords:** note-taking, reflection, self-efficacy, causal analysis

## 1. Introduction

With the growth of various types of learning which use information communication technology (ICT), a wide range of educational styles such as flipped classrooms and active learning have also been developed, using open educational resources (OERs) and social media (Hill, 2012). Though these educational styles are important current topics of study, encouragement of the student’s learning activity is still a key issue. This issue is often described as "self-regulated learning" (SRL) (Pintrich 2004) Learning progress can be evaluated using empirical descriptions such as survey data from student's self reflections.

In addition to this topic, the relationships between student's emotional factors and their learning activity or performance are often studied and discussed (Sierens et al. 2009, Papaioannou et al. 2012). Recently, the effect of participant's emotional factors in the online learning environment has also been discussed (Cascio et al. 2013).

Another conventional learning activity is note taking. Note taking contributes to student's learning activity and their learning achievement (Kiewra 1989, Nye et al 1984). As note taking activity affects responses to questions about student's reflections in addition to affecting their learning performance (Nakayama et al. 2016a, 2016b), instructions regarding note taking activity should be given carefully. The relationships between student's emotional factors and their learning performance are illustrated as causal models (Mega et al. 2014, Nakayama et al. 2016b). As mentioned above, note taking instruction as a form of learning support for participants of a course may encourage their responses to questions about self reflection beyond the development of their note taking skills. The progress of the effect of giving instructions on development of note taking skills should be examined in detail.

The purpose of this paper is to examine the progress of participant's development of emotional factors during a blended learning course after note taking instruction has been introduced. The following topics are addressed:

1. Changes in participant's self efficacy and reflection during a blended learning course which includes note taking instructions are measured.
2. Transformation of causal relationships between participant's self reflections and how the characteristics affect each other are examined.

## 2. Method

### 2.1 Blended learning course

The course "Information System Network", a Bachelor level credit course which consists of 15 weeks of face-to-face sessions, was selected for the survey (Nakayama et al. 2016a, 2016b). Since this was a blended learning course, online test assignments were given to participants using a learning management system (LMS). The lecturer asked all participants to take more detailed notes during course sessions and to present their notes for the evaluation. The students were encouraged to improve their note taking activity, and instructions were then given twice during the course, once early in the course and again at the midpoint.

### 2.2 Student's characteristics

Various characteristics of participants have been analysed by the authors (Nakayama et al. 2016a, 2016b), and these metrics are also surveyed in this experiment. In particular, information literacy and note taking skills are focused on, in order to observe contributions to changes in student's learning.

Information literacy is measured using a developed inventory (Fujii, 2007), with two factor scores which measure skills and attitudes toward information literacy being calculated. Note-taking skills are also surveyed using a questionnaire developed for the experiment. The skills surveyed consist of the following three factors, F1: Recognising note taking functions, F2: Methodology of utilising notes, and F3: Presentation of notes.

### 2.3 Participant's reflections

To evaluate changes in participant's emotional factors, two kinds of surveys were conducted during the course. The first one is a measure of self efficacy which was developed by Pintrich and Goot (1990) and is frequently used for assessing participant's emotions. The other one consists of participant's self reflections, on topics such as their level of satisfaction. Participant's self directed effort and the self assessment of the degree of their effort are also measured. Self satisfaction and study hours are frequently included in these course assessments (Nakayama et al. 2016b).

## 3. Results

### 3.1 Factors of self efficacy

**Table 1:** Question items for evaluating self efficacy and a factor loading matrix of two factors

| | Question item | Factor1 | Factor2 | Mean-F | Mean-S | |
|---|---|---|---|---|---|---|
| 3 | Compared with other students in this class I expect to do well | 0.81 | 0.02 | 3.19 | 2.69 | ** |
| 2 | I'm certain I can understand the contents taught in this course | 0.79 | 0.08 | 3.72 | 3.07 | ** |
| 8 | Compared with other students in this class I think I know a great deal about the subject | 0.70 | -0.09 | 2.56 | 2.54 | |
| 9 | I know that I will be able to learn the material for this class | 0.61 | 0.07 | 3.54 | 3.24 | |
| 1 | I expect to do very well in this class | 0.59 | 0.23 | 3.81 | 3.17 | ** |
| 5 | Compared with others in this class, I think I'm a good student | -0.09 | 0.77 | 3.17 | 3.04 | |
| 6 | I am sure I can do an excellent job on the problems and tasks assigned for this class | 0.02 | 0.72 | 3.56 | 3.37 | |
| 4 | I think I'll receive a good grade in this class | 0.20 | 0.59 | 3.24 | 2.70 | ** |
| 7 | My study skills are excellent compared with others in this class | 0.15 | 0.44 | 2.70 | 2.63 | |
| | Contribution ratio (of each factor with other factors eliminated | 0.18 | 0.12 | Inter factor corr | | |
| | Contribution ratio (of each factor with other factors ignored) | 0.40 | 0.34 | r = 0.6 | | |

Responses of participants to questionnaires about self efficacy in the two surveys, such as the first mean (Mean-F) and the second mean (Mean-S), are summarised in Table 1. There are significant differences in responses to some question items between the two surveys. Compared with the first survey, all means in the second survey decreased. Participants may be recognising and acting upon their own situation during the course.

To extract latent factors, factor analysis with promax rotation was applied to all responses in the two surveys. As a result, two factors structures were extracted. The factor loading matrix and pattern are different from the initial survey because the initial survey was conducted only once using a smaller cohort (Nakayama et al. 2016b). Though the structure is different, the two factors suggest "self confidence in student's own attitude" (SE-F1) and "self confidence in student's own level of competence" (SE-F2). The two factors correlate with each other, and the inter-factor correlation coefficient (r) is 0.60.

In regards to the results of factor analysis, the mean factor scores of the two surveys are summarised in the top panel of Table 2. As mentioned above, the scores of the second survey showed a decrease. There are significant differences in the means of the first factor (SE-F1) ($p<0.01$), though the means of the second factor (SE-F2) remain at the same level. This means that participants may loose some confidence in their attitude as a result of various learning experiences.

**Table 2:** Question items for assessing participant's reflection and their means in two surveys

| | | Question Items | Mean-F | Mean-S | |
|---|---|---|---|---|---|
| | SE-F1 | Factor1: self confidence in student's own attitude | 3.36 | 2.94 | ** |
| | SE-F2 | Factor2: self confidence in student's own level of competence | 3.17 | 2.94 | |
| 1 | Syllabus reading | Read the syllabus of this course carefully in advance | 3.46 | 3.07 | |
| 2 | Out-of-class study | Study out of class for this course | 3.11 | 3.29 | |
| 7 | Learning hours | Grade a level of learning hours for this course out of the class | 2.91 | 3.00 | |
| 3 | Self directed effort | Self assessment of own attitude towards this course | **7.22** | **6.91** | |
| 4 | Self understanding | Self assessment of level of understanding for contents of this course | **6.41** | **5.98** | |
| 5 | Self achievement | Self assessment of level of achievement for this course | **6.31** | **6.31** | |
| 6 | Self satisfaction | Self assessment of level of overall satisfaction for this course | **7.37** | **6.70** | * |

Bold means are based on a 10 point scale; ** $p < 0.01$, * $p < 0.05$

**Table 3:** Changes in factor scores for note taking skills between two survey during the course

| | 1st survey | 2nd survey | |
|---|---|---|---|
| NT-F1: Recognition of functions of NT | 3.74 | 3.86 | # |
| NT-F2: Methodology of utilising notes | 2.60 | 2.90 | ** |
| NT-F3: Presentation of notes | 2.47 | 2.82 | ** |

**: $p < 0.01$, #: $p < 0.10$

### 3.2 Changes in participant's reflections

Responses to question items for the assessment of participant's reflections in the two surveys are summarised in Table 2. The middle panel of Table 2 shows the means for three items using a 5-point scale, and the bottom panel shows the means for four items using a 10-point scale. Most responses between the two surveys are comparable, except for "self satisfaction", which decreases significantly in the second survey (p<0.05). Some participants might feel difficulty in learning the contents of the course.

### 3.3 Development of note taking skills

During the course, participants were given note taking instructions twice, and encouraged to make better notes. In order to determine the effectiveness of the instructions, three factor scores of note taking skills from the two surveys are compared in Table 3. All factor scores increased during the course. In particular, both NT-F2 and NT-F3 increased significantly (p<0.01). Many participants might have better learned for themselves the methodology of note presentation and utilization.

The development of note taking skills may affect participant's self reflection activity. The results of a detailed analyses are explained in the following section.

### 3.4 Causal relationships among metrics

The previous study suggested that note taking skills promote participant's proactive learning. To confirm the contribution of note taking skills to learning activity, causal analysis was conducted. The possible causal relationships between student's self reflections and other variables were examined using a structural equation modelling (SEM) technique. All parameters were estimated using AMOS software (Toyoda, 2007), and the validity of the models was tested using indices of the fitness of the model (the GFI: Goodness of Fitting index).

The variables involved were selected step by step, and a causal relationship as shown in Figure 1 was created. The multiple group structural equation modelling technique was applied to the sets of data from the first and second surveys.

The factor score of NT-F1 (recognition of functions of note taking) significantly affects several variables of self reflection, such as "syllabus reading", "out-of-class study", and "self directed effort". NT-F3 (presentation of notes) significantly affects "self directed effort". Factor scores of note taking skills affect "learning hours" which are an index of participant's proactive learning, to a significant extent. In comparing the coefficients of the first and second surveys, the direct relationship between NT-F1 and "self directed effort" is replaced by a path via "syllabus reading", while the influence of NT-F3 is less. As a result of note taking instructions, the relationship between "syllabus reading" and "self directed learning" has become enhanced.

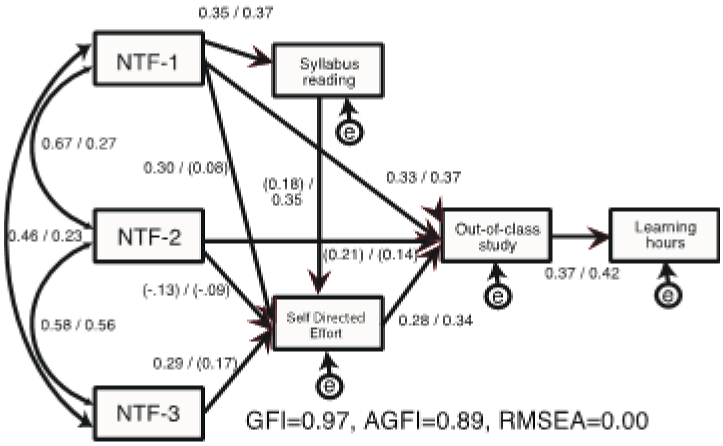


**Figure 1:** Note taking skills affecting metrics of reflections

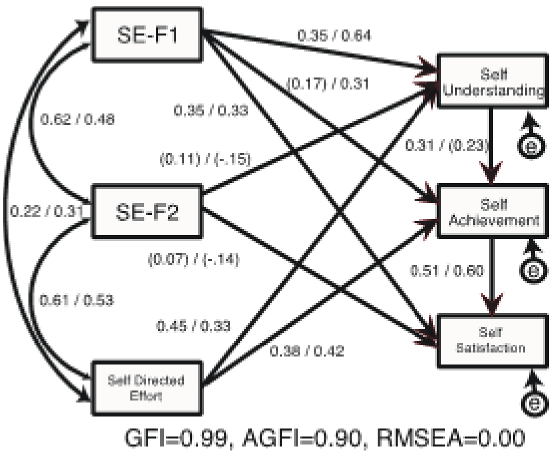


**Figure 2:** Factor scores of information literacy affecting metrics of reflections

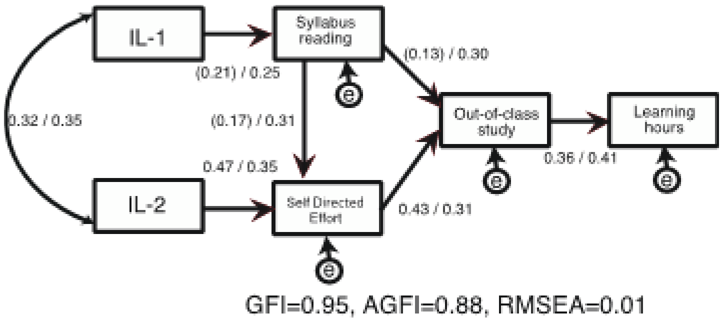


**Figure 3:** Factor scores of self efficacy affecting metrics of reflections

In the causal relational analysis shown in Figure 2, the effectiveness of the factors of information literacy (IL-1 and IL-2) is confirmed. In comparing the coefficients of the two surveys, IL-1 (information literacy skills) gradually promotes "syllabus reading", and "syllabus reading" significantly affects both "self directed effort" and "out-of-class study". Also, Figure 2 indicates that information literacy promotes an increase in the number of “learning hours”

The relationship between self efficacy and self reflections is examined. A causal relationship as shown in Figure 3 indicates the two factors of self efficacy and "self directed effort" which affect overall "self satisfaction". There is little change in coefficients between the two surveys. The factor of self efficacy (SE-F1: self confidence in student's own attitude) affects three variables, namely "self understanding", "self achievement" and "self satisfaction", in the second survey.

### 3.5 Causal relationships across changes in survey metrics

When the values of metrics between the two surveys are compared, various differences are observed. Though all factor scores of note taking skills increased, scores for responses regarding self efficacy decreased, and most self reflections between the two surveys were comparable. Therefore, an additional causal relationship of differentials in metrics between the two surveys was examined, as shown in Figure 4. Here, the differences in means for the scores of the second survey were less than those of the first survey (2nd score - 1st score). Since the differences in the two factor scores for self efficacy did not contribute to the other metrics, a separate model was created for these. The differences of both NT-F1 and NT-F3 affected some of the differences in self reflections, such as those regarding "syllabus reading", "self directed effort", "out-of-class study" and "learning hours". The degree of recognition of the value of note taking functions (NT-F1) and presentation of notes (NT-F3) contributed to participant's self reflection. In addition to this, both "syllabus reading" and "self directed effort" affected the difference in "self understanding" which transformed "self satisfaction" through "self achievement". The direction of the arrow from "out-of-class study" to "self directed effort" changed between Figures 1 and 2, in regards to the index of model fitness.

As a result, the improvement in note taking skills produced significantly positive growth of participant's self reflections during the course. These relationships will be keys to the improvement of overall learning activity.

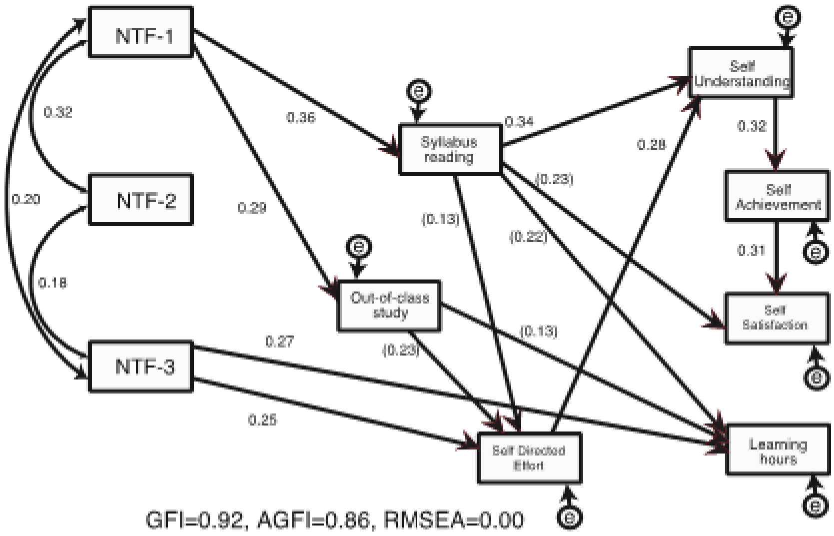


**Figure 4:** Casual relationship : development of note taking skills influencing changes in self reflections

## 4. Discussion

As the results in the above section show, most scores for both self-efficacy and self assessment decreased, though scores for note taking skills increased due to the note taking instructions that were given. In particular, the first factor score for self efficacy (self confidence in student's own attitude) decreased in the second survey. Even the score for self satisfaction decreased significantly in the second survey. These points suggest that participants gradually recognised their actual learning situation well and made additional effort to take better notes during the course.

On the other hand, two factor scores for note taking skills (NT-F2 and NT-F3) increased significantly. Participants may have understood how to use their notes outside of the classroom. Therefore, the contributions of factor scores to note taking skills for "out-of-class study" and "learning hours" increased slightly in the causal analysis in Figure 1. These contributions were supported by some of the student's characteristics, such as their level of information literacy (IL-1, IL-2). Figure 2 shows various interactions between factors of student's characteristics which may affect their learning behaviour.

Though the first factor score for self efficacy decreased in the second survey, the scores that represent self reflection, such as "self understanding" and "self achievement", increased. Changes of scores in metrics were observed and these scores affected other metrics through causal relationships. As a result, another causal relationship was created using changes in metrics, in order to show the spread of changes to metrics in Figure 4. As all coefficients are positive, improvement in note taking skills due to the lecturer's instructions affected most of the differentials of student's self reflections.

These results also confirm that note taking activity produces better responses to questions about participant's reflections except for those reflecting scores of self efficacy. The results mean that note taking activity affects participant's emotional factors.

The development of an improved procedure for evaluating all emotional factors, including self efficacy, will be a subject for our further study.

## Acknowledgements

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# Blending MOOCs in Face-to-Face Teaching and Studies

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**Abstract:** The impetus for this study stems from two opposing tendencies in the current Danish educational system. On one hand, there is a growing demand for improvements in both student satisfaction rates and dropout rates. On the other hand, there have been steady cuts in resources, particularly in terms of hours allotted for lecturers to meet existing demands. In order to design solutions to this challenge, this study collaborated with three educators and their 73 students in a teacher training faculty in Denmark, where Massive Open Online Courses (MOOCs) are already produced and available for teaching integration. The study experiments with different ways of letting MOOCs play supplementary roles in students' study work. The main research question we seek to answer is, thus, how MOOCs can contribute to improvements in teaching quality without increasing the number of lectures, while simultaneously supporting students in obtaining higher degrees of independence in study activities. The data are collected through literature reviews, interviews with the participants and observations of on-campus teaching integrating MOOC content. The resulting mixed data will be analysed using constant comparisons inspired by grounded theory. The paper will categorise former design experiments with MOOCs in blended settings, and, using design workshops and interviews with educators as our point of departure, we will sketch and discuss various models for blending MOOCs with face-to-face teaching and supporting structures for students' independent work in MOOCs outside campus.

**Keywords**: MOOCs, design-based research, teaching, blended learning, contextual mechanisms, design mechanisms

## 1. Introduction and context

In this paper, we present the preliminary findings of a research and development project aimed at implementing archived MOOCs as part of the regular bachelor's programme for teachers in primary and lower secondary schools. The project's initiation stems from two opposing tendencies in the current Danish educational system. On one hand, there is a growing demand for improvements in both student satisfaction rates and dropout rates. On the other hand, there have been steady cuts in resources, primarily in terms of the hours allotted for lecturers to meet current demands (Eistrup & Christensen, 2015).

One way of reacting to this pressure is to design ways to qualify students' work before, during and after face-to-face (F2F) activities to prevent the quality of their studies from suffering from the lack of instructor hours. In this particular project, we explore the potential of guiding students more actively towards relevant study resources. On the basis of already produced and achieved MOOCs, we experiment with designing solutions and models for different ways of letting MOOCs play a supplementary role in maintaining or even raising the educational standards of our teacher training programme.

The main research question we seek to answer is, thus, how MOOCs can contribute to improving teaching quality without increasing the number of lectures, while simultaneously supporting students in obtaining higher degrees of independence in their study activities. We begin by introducing our methodological framework, and we present a literature review of the recent research blending MOOCs and F2F teaching. On this basis, we categorise and discuss four different design mechanisms that seek to answer the above-mentioned solution. We conclude by illustrating our point in an exemplar case where one design element (integrating archived MOOC videos in the F2F teaching) was tested in teacher training in Danish.

## 2. Methodology

The project is methodologically inspired by design-based research (DBR) (Brown, 1992; Collins, 1992), and our design framework will be developed through iterative design experiments (diSessa & Cobb, 2004). The prototypes for the blended learning designs with MOOCs will be produced in collaboration with three educators and their 73 students. Afterwards, these prototypes will be tested, evaluated and redesigned. The project consists of four phases (McKenney & Reeves, 2012): 1) analysis and exploration (literature reviews, interviews with teachers and students and class observations), 2) design and construction (idea generation, sketching and prototyping) 3) design experiments (evaluation and reflection of differences among the intended, implemented and attained designs; redesigns/new iterations) and 4) implementation and spread. The project is currently in phase two.

DBR literature often stresses the importance of the team in phase two (Collins, Joseph & Bielaczyc, 2004; McKenney & Reeves, 2012; Petersen & Gundersen, 2016). Generating and gradually refining ideas calls for a group of people with a diverse set of expertise ranging from theoretically well-founded, divergent thinking to knowledge within the specific area of the intervention. In order for such a group to function, one must establish a shared language that facilitates concise communication on new and complex ideas. Thus, we have explored the potential of supporting the idea generation with visualisations of the basic design mechanisms and design parameters developed in phase one. These contextual mechanisms and design parameters are presented in the findings section in the paper.

## 3. MOOCs and blended learning

Research in designing, teaching in and learning through MOOCs is beginning to narrow its focus from a broad interest in MOOCs to more specific discussions relating to, for instance, the adoption of MOOCs in the field of education (Kovanović, Gašević, Joksimović, Siemens, & Hatala, 2015), and experiments with MOOCs in F2F contexts can now be seen (Bruff, Fisher, McEwen, & Smith, 2013; Li et al., 2014; Najafi, Evans, & Federico, 2014). The literature reveals that MOOCs often have high dropout rates (Greene, Oswald, & Pomerantz, 2015; Liyanagunawardena, Parslow, & Williams, 2014) and less intra-student and teacher–student collaboration (Abeer & Miri, 2014; Diver & Martinez, 2015; Smith et al., 2011).

Some experiments (Bruff et al., 2013; Najafi et al., 2014) have begun to answer these challenges with learning designs that incorporate existing MOOCs—so-called "archived MOOCs"—into F2F teaching in order to combine the most valuable aspects of live and archived MOOCs to best meet learner needs and interests (Campbell, Gibbs, Najafi, & Severinski, 2014, p. 258). This integration of MOOC elements into the classroom allows teachers to use existing materials (e.g. videos, assignments, quizzes) in instruction delivered on campus. The teachers in these studies (c.f. Fisher, 2014) point out that the workload in such teaching approaches is much smaller than their standard workload, since the lecture videos, assignments and other learning materials are already produced. The studies also find that the students are more active in the F2F context, since the teacher can engage more deeply in relevant discussions.

However, the blended MOOC setting also raises new questions regarding the teacher's role. Bruff et al. (2013) find that, compared to the traditional form of blended learning, more teachers are engaged in learning designs: one teacher that contribute to the design of MOOC elements and another teacher that design and more flexibly deliver the F2F portion. This points to the need for learning design considerations for when and how to most efficiently contribute to the enhancement of quality in F2F contexts that integrate MOOCs.

Experiments with MOOC content in F2F teaching can be found in Li et al. (2014), who encouraged students to watch MOOC videos in groups, rather than individually, to encourage collaboration. This study points to the advantages of this approach to flipping the classroom, in which the lecture takes place not as an individual activity, but as a collaborative one situated in groups on campus. Li et al. (2014) argue, on the basis of these studies in higher education, that communal video watching is a chance for students to qualify and concur understandings and discussions of difficult content.

Although some research has already been conducted in the area of learning design, some have pointed to the need for further research (Campbell et al., 2014; Fisher, 2014) that considers this changed role of MOOCs from learning environments and course designs to learning resources (Bruff et al., 2013) that can be integrated into several different F2F teaching approaches.

## 4. Findings

Below, we will present the findings from our initial phase of our project on MOOC blending. We have identified a number of contextual mechanisms that are important for the development of specific learning designs for blended learning using MOOCs. These mechanisms are critical to address during the design phase, with the teachers involved. Thus, based on the above review, we will present two of the design mechanisms that we introduced in concrete design workshops with the teachers.

### 4.1 Contextual mechanism I: Teachers' basic understandings of the purpose of MOOCs

The initial phase revealed three contextual mechanisms linked to teachers' basic attitudes toward MOOCs. The mechanism with the greatest impact on the design of blended learning with MOOCs is the teachers' basic understanding of the educational institution's goal in producing and implementing MOOCs within its training portfolio. The contrast between improved educational quality and resource savings as the starting point for this research was also evident in our interviews with the teachers.

Mary [all names are anonymised] stated, for instance, that "It was exactly that concern: if I was replaced because all of a sudden they found out that it was much better, what happened in there… One might say that the MOOC has replaced Jane and Hillary and so on. They're not physically present, are they? It is a replacement of them! That is how I felt it was presented [by the educational institution] ...".

Hillary expressed the same concern when she explained why she thinks teachers are concerned about the institution's integration of MOOCs: "Hm… you dig into something fundamental… it's all about how many students there are: the fewer students, the fewer teachers, so that's what's behind the concern... "

Jane did not share the same concerns as the other two about MOOCs being used to replace teachers: "No, because I do not think it [MOOCs] can [replace the teacher]. Teaching requires a teacher... So you could say that it does not matter that I taught at an institution, if they could just learn from each other and by reading a book… So if they do it [replace teachers with MOOCs], it's because they think it does not matter if we lower the teaching quality."

Given these perspectives, Mary had a very specific reason for joining the project: "To be honest, I'm participating [in this project] to show that I am irreplaceable!"

However, she also saw the pedagogical potential of the work: "In fact, it will take a burden off me to know that I can say, well, it's already mastered… Syllabus and literature etc. … Actually, a work burden is lifted off me when I can say: 'It's over there and is taken care of'. It's the syllabus and literature and so on which I don't have to deal with, so in that way, it will, in fact, facilitate my work. I only have to do the fun part (laughs)."

Thus, our first context theme concerning the teachers' understandings of MOOC can be visualized as follows:

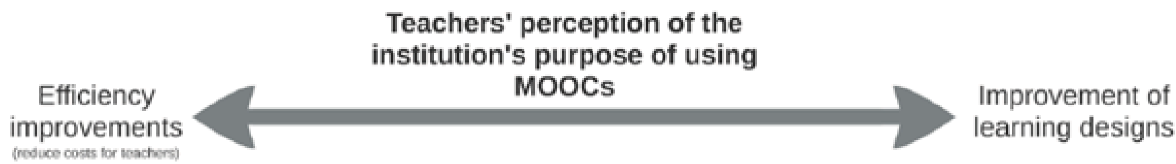


**Figure 1:** Teachers' perception of the institution's purpose of using MOOCs

The model highlights the contextual mechanism with the greatest impact on the design by showing the contrast between efficiency improvements and improvements of learning designs linked to teachers' basic attitudes toward MOOCs.

### 4.2 Contextual mechanism II: General understanding of MOOC affordances

The next context mechanism, which is almost as significant as the first, reflects the teachers' general ideas about the affordance of MOOCs. These ideas are closely related to their understanding of what a MOOC is. We find a fundamental contradiction between the teachers' understandings of MOOCs as "teaching and learning environments" and as "learning resources". Is a MOOC an environment or an artefact? The literature distinguishes between "live MOOCs" and "archived MOOCs" (Israel, 2015), but our distinction is more basic.

To illustrate, Mary perceived MOOCs as alternative learning environments: "Cut to the bone, I think, it is teacher training put into a different framework. Everything we teach is simply made digital and put up there... it is like seeing myself in slow motion, what happens on those videos, right? And I can see that all the texts and assignments are exactly the same as I use." Although Mary perceived the MOOC as teaching, her attitude was that the MOOC represents a lower quality of education than her F2F teaching: "I spend nearly 80% of my class time walking around helping, guiding and coaching. The students do not get that kind of help in the MOOC. There, they must do it all by themselves or in groups."

In contrast, Hillary believed that MOOCs were learning resources: "An MOOC is a resource... an online resource… some form of learning support [or] learning video that I can integrate in my lessons and let the students watch and interact with. I think that I have established a study room with highly qualified teaching. And the MOOC is a resource that they can choose to work with." But although Hillary perceived MOOCs as learning resources, she also feared that students would choose the MOOCs over her own teaching: "There are not so many [students in the class]. They slowly stop attending, so, sometimes, I have only five students present, and if I let them see the [entire] MOOC, I am afraid that they completely disappear from me... I am, of course, nervous that they will not show up if I say: ‘the entire program is online now to study and for the exam’... I want to keep it this way: that they are here [pause] ... with me."

Jane had the same opinion, and she did not at all interpret MOOCs as teaching: "I find it hard to use the word ‘teaching’ when speaking of MOOCs. But it's a form of digital education. But for me, teaching requires that there is an interaction between—maybe a more direct interaction—between teacher and student. In my opinion, in an MOOC, the students communicate more with each other. But a learning resource, maybe? ... Yes."

To summarize our second context mechanism, we can visualize this theme as follows:


**Figure 2:** Teachers’ general understanding of MOOC affordances

The model illustrates the fundamental contrast in understanding MOOCs as live environments and archived resources.

Closely related to the above context mechanisms is the teacher's need for autonomy in their learning design. The learning design in an MOOC is produced by others, which means that each teacher must either take over or remediate the design. This becomes especially important if a teacher sees MOOCs as additional or alternative learning environments; however, it does not have the same significance if the teacher sees MOOCs as learning resources in line with other resources, which teachers are accustomed to deciding how to use themselves. Mary stated: "I will decide what to teach. It is very important to me that it is me who decides... that it is I who have designed the tasks they have to do."

Hillary, who saw MOOCs as learning resources, did not have the same concerns: “What I think is pretty clever in an MOOC is that it's structured, so you… have a video, you have an intro video, you have a thematic video, and you have a quiz. The content is very compressed in each theme, and I think it works really well. Then, you can really dive into the theme and work with the things that you [the teacher] might not have covered or need to sum up instead."

## 4.3 Design mechanism I: Blended or sequenced learning

In relation to the development of specific learning designs, we found two basic methods of integrating MOOCs into general education on campus. One form can be described with the very popular term "blended learning". This term is a floating signifier, and definitions vary considerably. We use the following definition: “Blended learning courses integrate online with F2F instruction in a planned, pedagogically valuable manner, and do not just combine but trade-off F2F with online activity (or vice versa)” (Vignare, 2007 p. 38). In a “planned manner”, blended learning that integrate MOOCs can be used to blend MOOCS with F2F instruction for either the curriculum as a whole or part of the curriculum (c.f. Campbell, Gibbs, Najafi, & Severinski, 2014; Fisher, 2014; Li et al., 2014).

However, in a curriculum plan, it is also possible to divide the curriculum into themes—some for MOOC teaching and learning and some for on-campus teaching and learning. This kind of curriculum planning can be defined as "sequenced learning". To support the generation of ideas in the design phase, we visualize this point with the following model.


**Figure 3:** Curriculum planning

If MOOC elements are integrated into a blended learning design, one can draw on general research on blended learning in the phase of idea generation. Here, we will point to the potential for generating designs that integrate MOOCs either before, during or after F2F teaching (Garrison & Vaughan, 2008).

Sequenced curriculum design has two potential directions, which require two different types of sequencing. If a teacher wants more time with his or her students on campus (e.g. for specific topics that particularly benefits from the teacher and the students being in the same physical space), the instructor should develop a curriculum plan that we can refer to as "serial sequencing".

This can be visualized as follows:

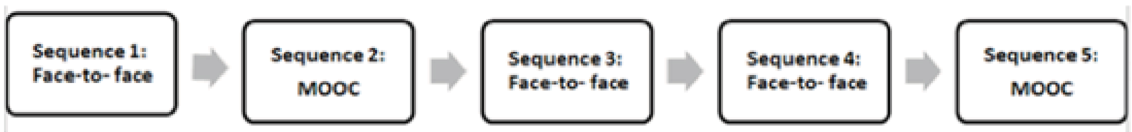


**Figure 4**: Serial sequencing

If, on the other hand, a teacher or an educational institution wants to give students the opportunity to choose whether to take a course as an MOOC or a F2F course on campus, this requires a curriculum design we can describe as "parallel sequencing". Parallel sequencing increases a program's flexibility and gives students the opportunity to pursue education even if they have to work, are traveling or are sick at times when F2F teaching is taking place on campus.

Parallel sequencing may be visualized as follows:

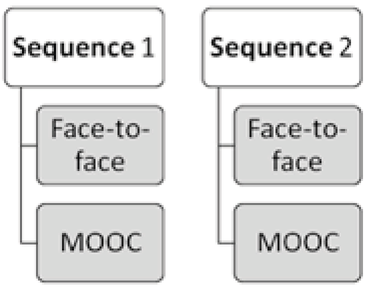


**Figure 5**: Parallel sequencing

### 4.4 Design mechanism II: MOOCs as teaching or studies

The final overall design theme we identified in the project's first phase concerns the use of MOOCs in two different educational arenas: teaching and studies. We define teaching as a teacher's intentional learning design based on specific learning objectives. According to this definition, activities related to teaching are initiated by the teacher. Furthermore, studies can be defined as activities initiated by students who aim to complete their education.

However, this division, which was initially found in a depiction of Danish teacher training activities, is too general. Instead, we propose a distinction between the use of MOOCs for teaching and the use of MOOCs to support students' study activities. Both are initiated by the teacher and/or the educational institution. Combining these two approaches with our distinction between blended learning and sequenced learning, we can visualize the project's basic design parameters:

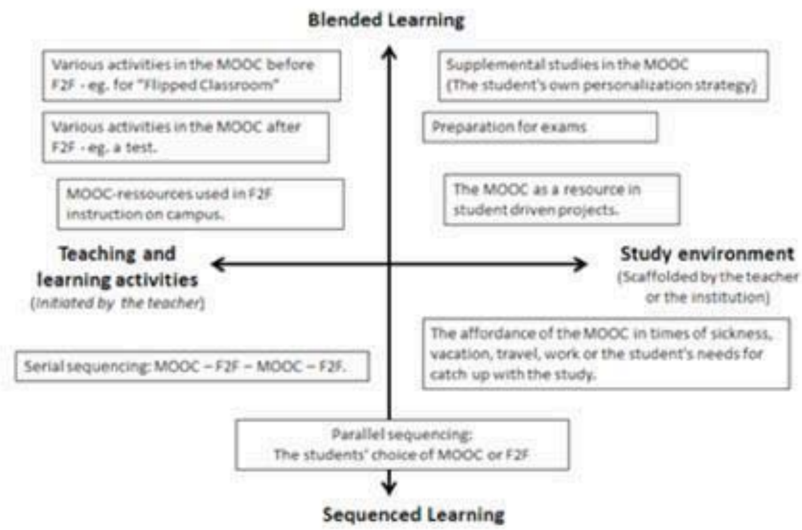


**Figure 6**: Basic design parameters in the project

Furthermore, we have identified two secondary design parameters, which may also be important for the overall learning design. One concerns the extent to which MOOCs are integrated into coursework. Here, the distinction is made between "MOOCs enhanced by Classrooms" and "Classrooms enhanced by MOOCs" (Ronkowitz & Ronkowitz, 2015). In our training program for teacher professional development, we use the first category. We apply the second category in cases in which MOOC activities represent only a small part of the overall training design.

In the planning phase, it is important to consider how the activities in a specific MOOC interact with other digital learning environments and other learning resources, including other MOOCs. A concrete learning design may consider the fact that, today, there are a large number of MOOCs produced by other institutions, meaning that a teacher's choice of learning design can take advantage of all these potential designs and integrate them into a learning design. This approach can be referred to as "the distributed flip" (Holotescu & Grosseck, 2014).

## 5. Case

To illustrate a part of this model (i.e. the upper left quadrant, "MOOC resources used in F2F instruction on campus"), we will conclude by presenting one of the first experiments blending MOOC with teacher training, with Hillary as the teacher. The goal of this case was to enhance students' collaboration on the basis of MOOC content, but without the facilitation of a physically present teacher. (The video was a picture-in-picture Power Point presentation of an analysis of picture books for children). As part of the preparation for class, the students were asked to read three texts on children's picture books. After a short presentation of the assignment in class, the students were told to form groups and to watch a specific MOOC video in these groups. One of the students in each group was asked to control the video (i.e. to pause or to rewind it when necessary). While watching the video, the groups were to discuss what they found most interesting. Thus, –as we are in the initial phase of a DBR project and are concerned with exploration of the context by the use of design experiments– our research interest in the case was how the students watched the videos and how the video elements from an archived MOOC were brought into play by the students.

Through our observations, we found that the student who controlled the video often paused it by framing an action with a question. For instance, he or she might say, "Hey, what did she [the teacher in the video] say?", "Did you get that?", "Do you understand that?" or "Do you agree that what she says here is that….?". During the break in the video, either this student would formulate in his/her own words what he/she understood to be the case, or he/she would ask the other members of the group to help do this.

Thus, the controlling student's choice of questions depended on his/her specific level of understanding of the content of the video: If this student was learning about picture books for the first time, and if he/she was not prepared for the lesson, he/she often rewound the video several times and wanted the group to take exact notes of the teacher's words. However, if this student already knew about picture books, and if he/she had read the assigned text beforehand, he/she was more inclined to pause the video to ask fellow students about their own ways of wording the content or about whether his/her own way of expressing the content was satisfactory to the group. All of the students in the groups paused and rewound the video many times, and these pauses gave them opportunities to reflect on the content at several levels and to listen and discuss the topic—in this case, an analysis of picture books—in more detail than they could have if the information were presented in class only once.

To sum up: in this design experiment case, we found that the integration of the archived MOOC videos as learning resources not only enhanced student activity and group collaboration (c.f. Li et al., 2014), but we also found that it facilitated individualised learning paths through a usually class-oriented activity of a Powerpoint presentation when integrated as a parallel sequencing of the traditional F2F lesson.

## 6. Discussion and conclusion

In this project, we experiment with answers to the question of how MOOCs can contribute to improving teaching quality without increasing the number of lectures, while simultaneously supporting students in obtaining higher degrees of independence in their study activities. As we are currently in the second phase of this DBR project, our results at this state are premature. As the experiments progress and are implemented and redesigned, other results will presumably surface and refine or perhaps reject our initial designs. However, so far, our observations, interviews and literature reviews have shown that integrating MOOC elements into F2F learning designs can help teachers make efficient use of their classroom time, since they can use MOOC elements as resources that they would otherwise have spent time producing (e.g. PowerPoint presentations, quizzes or assignments). However, we found in our review and in our interviews and observations, that our so-called contextual mechanisms play an important role in whether MOOCs are actually integrated: some of the teachers in our study saw MOOCs as potentially threatening to replace them, and they had second thoughts about "setting their students free" with a whole MOOC. On the other hand, teachers who saw opportunities for learning design enhancement via MOOCs as resources were more inclined to integrate its elements before, during or after their F2F teaching. For instance, these teachers saw the integration of MOOC videos to be watched in groups in the classroom as opportunities for students to follow content presentations in more individualised ways and for the teachers to spend more of their time in the classroom on guidance/facilitation, instead of lecturing.

Both our literature review and our preliminary findings showed us that more research and empirical experiments are needed to saturate our categories and models distinguishing among the various integrations of blended and sequenced learning in both teaching and studies.

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# Virtual Collaborative Research Communication the Impact of Mindsight

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**Abstract**: The overall research aim is to establish if mindsight can improve communication in virtual spaces, whether the platforms are organisational or in a learning setting. Businesses, organisations and educational institutions etc. utilize virtual teams and virtual enterprises; therefore, the ability of people to communicate effectively in virtual spaces is important. Some problems of communication in virtual spaces have been identified as lack of mutual trust and extensive communication among individuals (De Paoli, 2015; Januska, 2011). This aspect of interaction is because communication in virtual spaces involves people from different backgrounds and there are different expectations. A mental health theory called mindsight has been used extensively in relationships; the theory specifies that, people must understand themselves first, before being able to understand others. Mindsight facilitates connection with self and others through a combination of insight and empathy; this enables individuals to resonate with their experiences. The theory has not been applied to communication in virtual spaces and it is has been interesting investigating its impact on communication in virtual spaces. A qualitative pilot action research was conducted within a small virtual group of university students using two blogs. The students were divided into two groups between the blogs. All the students had little or no knowledge about mindsight. The first group of students were given some mindsight instructions to follow while engaging with the blog and the second group engaged without instructions. At the end of the interactions, questionnaires were handed to them to evaluate the levels of their communication. From the preliminary evaluation of the students' feedback from the session and the communication pattern on the blog; It was observed that the students that had mindsight instructions communicated more calmly and they were able to accommodate different opinions with a sense of acceptance and focus. The findings suggest that mindsight has the potential of improving an individual's communication levels to be more open to others as a result of self-awareness and integration. This a pilot study and more development of a mindsight virtual communication model will be used for the Researcher's main data collection.

**Keywords**: virtual collaborative research, virtual spaces, mindsight, communication, virtual communication

## 1. Introduction

Until recent times, a lot of people were not interested in communication that was internet enabled because, first, it was too expensive and distant from the reach of most people; and so, it was not easy then to reach people. Modernised communication has altered this phenomenon and has changed people's interest (Ale Ebrahim, Ahmed and Tara, 2009). The past two decades have witnessed the maturing of the internet and now, activities that were only possible in physical spaces are now obtainable in virtual spaces, (Ale Ebrahim et al, 2009; Kellerman, 2014; Skold, 2011; Yu and Shaw, 2008) . Diverse activities that were unattainable in physical spaces are now feasible in virtual spaces (Kellerman, 2014). For instance, the sophistication of the virtual space has permitted the synchronic presence of people in both physical and virtual spaces (De Paoli, 2015; Shaw, 2008). This process has made life flexible, people are no longer constrained by time and place to perform certain activities; they can function virtually in virtual spaces (Shaw and Yu, 2009). This has paved the way for individuals who live in distant places to be cognitively close to one another (Rodriguez, Bertone and Garcia-Martinez, 2010a) and has positively altered the way people interact (Yu and Shaw, 2008) .

Going beyond individual realms, enterprises now have the ability to collaborate further with other organisations beyond their geographic and organisational horizon (Godwin and Rennecker, 2000). Job activities have been made different by a way of virtual distribution (Ale Ebrahim, Ahmed, and Tara, 2009). This collaboration is made possible via virtual spaces such as, emails, websites and video conferencing facilities (Bosch-Sijtsema and Sivunen, 2013; De Paoli, Ropo and Sauer, 2014). Communication in virtual spaces triggers some sensations more than others. People who do not know one another have to communicate sensitive issues (De Paoli, 2015), and communication done over the internet is usually different from face-to-face communication (Prieto-Arranz, Juan-Garau and Jacob, 2013). Consequently, there have been complaints about difficulties that are encountered when communicating and connecting with people from different countries, religions and identities. Most times people have never known one another, or physically met before (De Paoli, 2015; Januska, 2011). Other problems that are outside the scope of this research include online trolling, where some individuals behave in a disruptive and deceptive way, on social media for no reason which causes unnecessary chaos. This can make their victims to appear or seem to be too nervous and irrational when approaching virtual communication (Buckels, Trapnell and Paulhus, 2014). This paper will address these problems by investigating the impact mindsight has on communication in virtual collaborative research being a type of a virtual space.

## 2. Related literature

### 2.1 Virtual spaces

A virtual space is defined through each word that is contained in the term, where 'virtual' means a functionality that is aided by computer networks; 'space' is an interactive setting (Sköld, 2011). To sum it; A virtual space is the conceptualization of the interactions that happen over a *computer network* ( Chandler and Munday, 2011; Welinder et al, 2014) these interactions are said to be enhanced by a means of *electronic connections* for the purpose of information exchange among people while they are located in different locations (Yu and Shaw, 2008). This is likened to a room that is created by a means of a *computer application* installed solely for the purpose of content sharing among people that also provide forum for communication and interaction (Welinder et al, 2014).

Virtual space is a universal term in literature that connotes virtual environment, virtual world, and collaborative virtual environment (Sköld, 2011) and it is used in diverse ways (Schroeder, 2012). It is also an umbrella term that represents others such as: virtual world (VW), virtual learning environment (VLE), collaborative virtual environment (CVE) and multi-user virtual environment (MUVE) (Sköld, 2011). Other scholars like Galambos, Weidig et al (2012) use virtual space interchangeably with virtual reality and virtual environment. While Yu and Shaw (2008) said virtual space is also called cyber space. Drawing a stance, virtual space is an umbrella term that represents all the terms mentioned above with the exclusion of virtual world and virtual environment due to the inherent difference in the experience of the users of these two environments. This is because, virtual world and virtual environment are displays that are generated by computer, which enable users to feel that they are present in an environment which is not real and are able to interact with it (Schroeder, 2012). The focus of this research is on the virtual spaces people use for the purpose of communication that does not entail any form of artificial environment or experience. This means network connections that are established for the sole purpose of communication. To this end there are some network communication connections that are developed for research purposes and knowledge transfer called virtual collaborative research.

### 2.2 Virtual collaborative research

A research team can consist of people that are not necessarily from the same institution or nation but the only prerequisite they need is to have a common research group. This is because virtual communities are formed by people who may be geographically dispersed but close cognitively. The concept of virtualization has encouraged the impression that groups are not a summation of people but an outcome of a network of the representative of systems, reflections and practices. In this network that is about the sharing of meanings between researchers about the item and project of research, a type of institution is developed where status is gained and the outcome of the research is appreciated. (Rodríguez, Bertone and García-Martínez, 2010b) Hall Jones et al (2015) in their research about collaborative argumentation construction for participants that collaborate synchronously cited that human conducts that promote collaboration are coordination, communication, and sharing of information. Table 1 displays the conceptualization of the collaborative technologies that are used for the purpose of virtual collaboration.

**Table 1:** Conceptualise collaboration technologies, adopted from Hall, Jones et al (2015)

| | Same Time Communication | Different Time Communication |
|---|---|---|
| Coordination | Location Tracking.<br>Session management.<br>Floor control systems. | Calendar Scheduling<br>Workflow management |
| Sharing of information | Meeting facilitation systems.<br>Whiteboards<br>Application sharing systems | Team workspace.<br>Websites.<br>Wikis. |
| Communication | Instant messages.<br>Text messages.<br>Telephone calls.<br>Video conferencing. | Social media sites.<br>Blogs<br>Emails<br>Voice mails. |

### 2.3 Mindsight theory

Mindsight is a theory developed by Dr Daniel Siegel; he discovered that when he communicated with his patients, “they said they felt, felt by him”. They had a sense that he understood what they meant and felt. Therefore, he termed the process of feeling felt *mindsight (*Siegel, 2010*)*. He stated that, mindsight is the ability to discern thoughts and identifying them as activities of the mind and it is being able to appreciate or notice the thoughts of others so to really understand their point of view, which enables responses to be compassionate and effective. This enables people to direct their feelings and thoughts and not to be driven by them, and are then able to balance their emotions, to achieve a state of equilibrium (Siegel, 2010).

Having claimed that, the mind is a process that coordinates the flow of energy and information, while relationships show how energy and information are managed and shared among persons through the technique of engagement, connection and random communication (Siegel, 2010). These relationships do not only apply to personal levels but can be applied on larger entities like communities (Clinton and Sibcy, 2012). Therefore, it was concluded that mindsight forms the base for social and emotional intelligence (Hernez-Broome, 2011). For instance, Heydenfeldt (2010) agreed that, companies that nurture socially intelligent behaviour (awareness, empathy, flexibility and resilience) have a better chance of surviving crisis and are able to prosper in the midst of it.

### 2.4 The impact of mindsight on communication in virtual collaborative research

It can be asserted that virtual collaborative research is important to researchers; thus, the utilization of the setup could be directionally proportionate to individual user’s ability to communicate effectively. This claim is indirectly supported by Malmelin (2007)’s argument about communication that the success of businesses depend on effective communication. This argument is paramount in the sense that communication is important to any business set up, and this communication could include communication in virtual spaces.

Hence, communication is a process where one mind affects another and also a mechanism that affects another mechanism. This could be in the form of oral and written communication. It can also take the form of images and sounds (Shannon and Weaver, 2015). Looking deeply into the collaborative process of communication; Hedman and Valo (2015) stated that, it is an ongoing process, through which individuals produce their perceptions and actions in a collaborative manner with others. This technique creates social worlds instead of just disseminating information between people. The fact that communication is not just a mere means of disseminating information only but also a means of developing social entities for co-creation of our understanding should lead to the decision to approach it with a sense of awareness of ourselves and others. Consequently, individuals that are utilizing virtual spaces meant for research should be more akin to this fact as they try to birth knowledge together. Regrettably, this is an experience that eludes many as they struggle to communicate via this connection. Just as De Paoli, Ropo and Sauer (2014), reports that, people find it difficult to communicate effectively with others in virtual spaces the reasons being that people come from different backgrounds and they have not known one another before. If communication must not just be a mere exchange of information, then how can effective communication are achieved, most especially in a virtual collaborative research.

This leads to the inclusion of the bridge of mindsight formed on the bases that it enables individuals to envision what is going on within them and to understand their minds and to resonate with their experiences. It helps them to be mindful of their mental operations and stop them from being carried away by them. This ability to comprehend the workings of the mind within a group also helps leaders in organisations (Siegel, 2010).

## 3. Research methods

Much deliberation was carried out in selecting qualitative approach in retrospect to the research questions and objectives of the research. Having the question: can mindsight facilitate an individual’s ability to communicate effectively in a virtual space? The question seemed to present with it a challenge to be investigated more deeply, hence the choice of the qualitative research instead of a quantitative method that will involve the counting numbers. Yin argues to achieve depth in understanding; qualitative approaches are an effective method of investigation. (Yin, 2012)

Hence, the pilot study was carried out on an online participatory action research. This was conducted within a virtual group of final year, computer science, university students using two blogs. These students form a type of audience that the research tries to address, since the focus is on virtual spaces. This was a research with the people and for the people as opposed to performing research on people as Reason (1988) argued.

The students were divided into two groups between the blogs; this process was carried out according to the student's level of openness to psychological interventions. Those who that were more open to the idea of Mindsight as an aid to their development in one group (group A) and those who seemed to resist these kind of approaches in another group (group B). All the students had little or no knowledge about mindsight. The first group of students were given some mindsight instructions to follow (Group A) while engaging with the blog and the second group engaged without instructions. The instructions were given to them immediately before the blogging session started in written format. The blogging session was a short timed event, with a specific starting point and end point lasting one hour.

At the end of the interactions, questionnaires were given to them to evaluate the levels of their communication. Observation and analysis were carried out by overseeing the level of interaction in the blog and by analysis of completed questionnaires given out at the end of the blogging session.

It was observed from Group A, students with mindsight instructions that their discussions were more coherent compared to their counterparts without instructions, despite most of them not having sufficient night rest the day before (their answers from the questionnaires). When asked," How well did you empathised, listened and understood the opinions of others" most of them claimed that they were more empathetic and understood the views of their blog members, compared to their counterparts without instructions. However, both groups claimed that they were calm and focused.

Based on the experience from the pilot study, the main data collection will still utilize two separate blogs would be used to collect narratives from participants about the impact of mindsight on their communication; potential participants have been identified from a Mindsight conference that was held at the Sage Centre, Newcastle, in April 2015. People have already shown interest in participating on the follow-up study after the conference. Therefore the blog design will have more feature functionalities such as the "I liked" statement, so that individuals could rate a person's statement, such as on a Likert scale. This was a suggestion made from the pilot study. Secondly, the blogs will run for a longer period of time to allow for more relaxed participation. Therefore, the main data collection will use l form an online participatory action research (PAR) among the participants.

These participants (turned co-researchers) will first study more about mindsight and its applications to their work and daily lives. Then they shall study how mindsight has enabled their communication within the online facility (virtual space) they have been using for the study. This process will help advance the idea of mindsight, according to Chevalier and Buckles (2013). PAR encourages ideas that are very important to the development of knowledge that is very useful to knowledge systems. This will help the researchers to be able to democratically produce and use the knowledge they have generated (Brydon-Miller, Greenwood and Maguire, 2003). Furthermore, it implies that all the participants in the research will contribute to the innovative thinking, which means that they will be involved in taking the decision on what to look at, about the processes that will be involved and they will collectively make sense of what is going to emerge as a result of their research together. They will be expected to take action on the subject of the research (As they will be told to apply the concept of mindsight to their communication in their organisational virtual spaces). This whole process diminishes the distinction between the researcher and his subjects as both the researcher and participants of the research become co-researchers (Reason, 1988). Hence, the successive logical steps that connect the research question to the data that will be obtained will navigate toward the recommendation and conclusion of the study.

## 4. Conclusions and recommendations

There is evidence observed from the pilot study, that mindsight might affect more particularly enhance communication and there is need to build this evidence in a more rigorous manner through the main data collection of the research. This will be achieved by a process of further qualitative research that will give more depth to the phenomenon to gain additional understanding and to create additional impact in business. Organisations, educational institutions and setups of virtual communication.

The focus of the next phase of the research will be with organisations, mainly because of opportunities that have been established. An additional action research event with practitioners from different organisations, studying mindsight together in a virtual collaborative research will be done as earlier mentioned. The process will concentrate on the analysis of communication of individuals in their organisational virtual spaces. Other aspects of the research related to this activity include the exploring of the definition of communication and what effective communication implies; it has been illustrated in literature that there are many contradictory definition of communication. A selection of communication definitions that relate directly to mindsight and virtual communication shall be explored to compliment the purpose of the research, which is to investigate the impact of mindsight on communication in virtual spaces.

It is anticipated that the research will proffer solutions that would lead to expressive communication in virtual spaces. Further clarity about the technology platforms that would be utilised in the research will be considered because the platforms and technology chosen will be the ones that will facilitate the purpose of the research, this also includes the decision whether to consider synchronous and/or asynchronous media.

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# On Design of Online Learning Environments for Programming Education

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**Abstract**: Programming is a fundamental and mandatory subject in Computer science programmes at university level, but many students have difficulties to learn even the most basic programming concepts and techniques. Computer science has a tradition of face-to-face *programming huts* where students taking programming courses can explore important programming concepts with instant feedback from human facilitators. In contemporary blended learning where more and more of teaching and learning sessions are given by distance there is a need for online alternatives for self-learning. At the department where this study was conducted about half of the students fail to complete their introductory programming courses and many other universities face the same problem. Without facilitation, online or face-to-face, and appropriate alternatives for self-learning the fail rates would be even higher. The *N-generation* or the *Digital Natives* that now are entering university programmes are the first generation that has used computers, Internet and online systems since early childhood. Their digital prerequisites are better than earlier generations but at the same time they have higher demands for interaction in online environments. In this study two different online learning environments for self-learning were analysed and discussed to find answers to: *"What are the most important factors in the design of virtual learning environments for self-learning of fundamental programming skills and knowledge?"* The overall research strategy is the case study approach where students' attitudes on the use of online learning systems have been investigated in two programming courses. Data has been collected by interviews, evaluation questionnaires and group discussions. The explored online learning environments in this study are Pearson educations' *MyProgrammingLab* and *Codecademy*. Findings indicate that online systems have to be carefully designed if they should attract the digital natives generation. Some important design factors for self-learning systems found in this study are: unambiguous exercises, clear and well-formulated feedback, user-friendliness, GUI design, multi-modality, gamification and curriculum alignment. Interesting extension of user-friendliness is if the programming exercises have multi-lingual descriptions and if the online systems might be adapted for students with different learning styles.

**Keywords:** online learning systems, self-learning, programming education, codecademy, myprogramminglab

## 1. Introduction

Programming education at university level in the 21st century has been identified as a problematic area (Guzdial & Soloway 2002; Lahtinen, Ala-Mutka & Järvinen, 2005; Mozelius & Olsson, 2015), with problems for students not only to understand theoretical concepts but also to get started in code construction and to learn the practical part Eckerdal, 2009). Several research studies have reported about low motivation and high dropout rates (Jenkins, 2002; Wiedenbeck Labelle & Kain, 2004; Mozelius, Torberg & Calderon Castillo, 2015). The tradition of face-to-face facilitation in programming huts in programming education is costly and something that many universities want to replace with online alternatives for self-learning (Mozelius & Olsson, 2015).

The generation that now are entering university programmes is the first generation that have used the Internet since early childhood. They have in research been named *The Digital natives* (Prensky, 2001), The *Net-generation* (Spires, 2008) and *Generation Y* (Mozelius, 2012). Whatever term, the vast majority have excellent basic computer skills and are comfortable with online environments. There are good reason for assuming that today's student batches have the prerequisites to use Internet based systems for self-learning if they find the systems valuable and motivating.

An online platform for programming activities that has got positive media publicity is the New York developed *Codecademy* (Wortham, 2012; Mims, 2014). Another similar online idea is MyProgrammingLab, a platform that has been promoted by the book publishing company Pearson Education (MyProgrammingLab, 2015). Both these environments seem like promising additional tools for self-learning in programming courses at university level. This is a field that lacks research, but there are some minor studies conducted at universities in Scandinavia that indicates that this type of online environments have a strong potential to strengthen students' programming skills (Brekke, 2013, Högberg, 2015).

### 1.1 Research question

The main question to answer in this study is: What are the most important factors in the design of virtual learning environments for self-learning of fundamental programming skills and knowledge?

## 2. Extended background

The most difficult aspects for many to learn programming is to learn syntax and to understand different paradigms and coding concepts. There are many ways to achieve the same result. What in one situation is the best code does not necessarily work well in another situation. Another challenging part of learning a programming language is to understand the necessary technical concepts.

To learn to program requires to be able to see the big picture and a deeper understanding of structures and concepts usually comes over time and not immediately. Patience and motivation are important factors and to sit and concentrate for hours of practicing and coding. In the traditional classroom, students are fed with a lot of information to be processed by their own potential. How their skills then are assessed are mainly based on how much information they can memorise.

### 2.1 Multimodality

Multimodality is about involving several different resources concurrently in communication and consequently in learning. Within multimodality, media/interface can be distinguished from the actual building blocks, or the sign systems of communication. Media/interfaces could be books, computers, radio and TV. Examples of sign systems are words, colours, gestures and sounds (Allwood, 2008). The different sign systems have different meanings depending on which media/interface they are used. Furthermore, there are differences between images, verbal language, sounds and gestures etc., which have different meanings depending on what genres and sign systems that are assigned the role of significant information mediator.

Communicative patterns are indeed different today compared to previous generations' ways of communication (Selander, 2013). Information is nowadays easily accessed and comes from many different sources today, due to new technology and digital media. Approaches to learning new things have followed the development and we learn new things in a different ways than before along with digitalisation and new technologies.

Verbal and written communication is not enough to understand the new communicative patterns. Consequently, other modes of communication is needed to handle the information and to learn new things. Thus, multimodality, or the multi-modal character of communication must be comprehended (Kress & Selander, 2012). Communication resources, or the different communication "modes" are culturally and socially designed. The design has been done in different processes of meaning-making and therefore their meaning can change over time (Boistrup & Selander, 2009).

### 2.2 Multilinguality and mother tongue

There are several research studies indicating that young students' use of their mother tongue is an important key to learning (Cummins, 2001; Ball, 2010). When children have opportunities to learn in their mother tongue, they are more likely to enrol and succeed in educational activities (Kosonen, 2005). But also in higher education there are examples of a crucial issues in course design such as the description of technical activities (Pierce & Robisco, 2010).

A field of problematic learning involving technical activities is programming education. As found in a study by Pillay & Jugoo (2005) students whose first language is not the same as that used in the instruction of a programming course did not perform as well as the rest of the group. Two ways of addressing this problem in programming education is either to design everything in students' mother tongue (Souya et al., 1991), or to choose the more complex multilingual design (Yeum et al.,2007)

### 2.3 Learning styles

A learning style can can be described as *"... the way each learner begins to concentrate, process, and retain new and difficult information"* (Dunn, 1990). There are various ways of dividing students into learning styles. One is the Kolb (1985) matrix where learning and problem solving are closely aligned. The four quadrants in the Kolb matrix are learners who prefer *active experimentation*, *reflective observation*, *concrete experience* and *abstract conceptualisation* (Kolb, 1985).

Another widespread model is to separate students into *visual*, *auditory*, and *kinesthetic* learners (Gilakjani, 2011). This division can be useful as a checklist in content developing for online learning where a common error has been to only provide content for the visual learning style. Most students have a mix of these learning styles and a majority prefer to have multiple modes learning content (Lujan & DiCarlo, 2006). A common mistake in what has been called eLearning 1.0 is the overuse of text files which works well for visual learners but not for auditory, and kinesthetic learners.

A third model found in studies of students in programming courses is the one used by Feldgen & Clua (2004) where the main two learning styles are *analytical learners* and *global learners*. Persons in the analytical learning style category like to read and learn things alone, spending time on analyses and systematic problem solving. In contrast to persons in the global learning style category who have less tendency to dig in to details, and clearly prefer to collaborate with other students, and have a greater need to see the big picture instead of analysing parts and details (Feldgen & Clua, 2004).

## 3. Method

The research strategy has been a case study with two embedded cases consisting of two programming courses at a department of computer science where one of the authors is the subject matter expert and main course developer. The first course is an introduction to computer programming in the Python programming language using one of the textbooks that is closely aligned to the MyProgrammingLab virtual learning environment. The second course is a course on web programming for the same student group with a mix of participants from a Bachelor programme on *Interaction design* and participants from a Bachelor programme on *IT and market communication*. There are all together around 120 students enrolled for both of the courses with a quite equal gender mix. Students were in the first course mainly offered MyProgrammingLab and in the second course both learning environments.

A case study has been defined as an investigation of a real world phenomenon (Yin, 1989) that can be an activity, a process or a unit explored in depth using a mix of data gathering methods (Creswell, 2009). Case studies should also have a focus on one, or a few instances of the selected phenomenon with the aim to result in an in-depth description of activities and processes in the particular instances (Denscombe, 2003).

Data has been collected in a combination of a literature study, interviews with students, group discussions at examination seminars and from course evaluation questionnaires that have been distributed electronically and anonymously. Questionnaires have had a respond rate around 30%. Furthermore, there have been analyses of students' study patterns in the MyProgrammingLab learning environment and students´ postings in for a in the Moodle virtual learning platform.

## 4. Interactive online environments

### 4.1 MyProgrammingLab

MyProgrammingLab (MPL) is an online environment created by Pearson Education and includes tutorials, homework and assessment to learn to program. The system reacts to the way a student performs a task and offer data-driven guidance to assimilate both the course material and the concepts of programming (MyProgrammingLab, 2015). Homework or the programming tasks in the system are closely aligned to the Pearson course books. The tasks focus on certain subjects and the students get immediate feedback on the results, since the results are automatically evaluated. (Mozelius & Olsson, 2015)

With the concept of MyLab, *Pearson education* has tried to create a collection of online environments for self-learning that are aimed, at an individual level, to help students to improve their results in higher education. With millions of student testing the MyLab-systems annually, the objective is to create online learning environments that are continuously adaptive. Earlier, the "One size fits all approach" to learning tools has shown to not suit anyone particularly good. With this lesson learned, one idea with the MyLab concept is that students should use learning tools that are genuinely personalised. (MyLab & Mastering, 2015)

MPL provides an online repository of programming tasks, where students individually can test their skills and knowledge by writing small code-snippets as answers to given assignments. The training starts with basic exercises and then gradually progress to more complicated and more difficult programming assignments. One design idea is to provide immediate feedback where students should be able to identify both compilation and logic errors in the code to eventually create longer and more complex code solutions. (MyProgrammingLab, 2015). The MPL assignments are closely aligned to a recommended course-book, which in this case study is *"Starting out with Python"* by Tony Gaddis (2014).

### 4.2 Codecademy

Like MyProgrammingLab, Codecademy is an online learning environment that provides free interactive programming courses. Zach Sims and Ryan Bubinski created the Web service to facilitate the learning of programming. They themselves became frustrated by the difficulty level when they were learning programming, which made them investigate other ways to ease the learning to code. They concluded that the problem of learning through books or videos is that there is a lack of reward after a book is read or a video is watched. In Codecademy's interactive interface, the user gets points after every completed section to motivate to continue to the next section (Vincent, 2011).

Everyone who join a course will be provided its own profile in the platform. Feedback is available and a feature built into the site keeps track of each user's total score and total day streak. The scores and the daily streaks are also displayed to other users. The courses are based on difficulty progression, but the user also has the option to choose which section to be performed at a certain time. Programming is taught through seeing, testing and creating the program code, with the intention that the course participants understand what actually happens behind the code. To help learners solving the tasks hints, Q&A-forum and direct feedback are provided. A progress bar that shows how much of a course that is completed and to increase the motivation to continue is displayed when entering the system. (Högberg, 2015)

Codecademy wants to change education by bringing classroom online. The courses provided by Codecademy are innovative and interactive with programming taught through seeing, testing and creating the program code, with the intention that the course participants understand what actually happens behind the code. Everybody who join a course will be provided its own profile in the platform. Feedback is available and a feature built into the site keeps track of each user's total score and total day streak. The scores and the daily streaks are displayed for other users as well. After completing the exercises a badge is obtained. Moreover, Codecademy provides a forum where the users can meet and help each other regardless of skill level. (Codecademy, 2015)

## 5. Findings and discussions

### 5.1 MyProgrammingLab

Based on answers in the course evaluation questionnaire three MPL user types has been identified. The first type is the kind of students that never logged in to the system after the initial workshop where the system was demonstrated. Second type is the group of students that used MPL for the first initial course sections with fundamental programming concepts like: constants variables, operators and selection structures. The third and relatively small group of students consists of the ones that used MPL during the whole course period.

One course participant writes in the questionnaire that *"I've mainly used MPL to train on basic definitions and what I see as a problem with using the system is the limited possibilities to help if you get stuck …"*. Other students also brought up in the group discussions at the examination seminars that they mostly found MPL useful *"for shorter exercises on basic programming techniques"*.

In one of the evaluation questions students were asked to mark to what degree they would recommend MPL to other students on a scale from 0 to 10. Not more than 8 % filled in a higher rank than 6 and the mean value was as low as 4.65. Some of the respondents wrote that they did not find MPL to be useful for themselves and their learning needs, but thought that it might be valuable for other course participants and that the basic idea of including MPL in a course is relevant. Students were generally more satisfied with the course book that the MPL exercises are based on and, compared to other programming courses, there was a relatively high number of students that bought and read the course book. For this test group all students could use MPL, without buying the course book or paying any fees.

Several students mentioned that the given feedback was hard to understand and one student described the exercise comments as "sometimes unclear and annoying". Another respondent writes that *" … it was often hard to find where the errors are in the code and the general feedback was poor".* Based on the collected data it is hard to say if this partly could be a language problem or not.

Furthermore, many students found the interface to be ugly and not user-friendly and some recommended Codecademy and Team Treehouse as more user-friendly online learning environments. At the examination seminars at the end of the course other students also mentioned Codecademy as a useful online system that they preferred to MPL. Some of students also mentioned that they missed the gamification that is implemented in the Codecademy system where students' performance and progress are illustrated graphically.

### 5.2 Codecademy

That the students experienced Codecademy positively is clearly indicated in the interview responses. They enjoyed learning through the system and appreciated the feedback that the system provided. One student said: *"Codecademy knows what has gone wrong, and gives suggestions on how to do instead".* Another student pointed out that *"it was always tools for help for each step, then it was fun that there is a result-box".* Other comments about the visibility and self-learning in the system were: *"I learn best figuratively. When I see the results and can look at it… this is how it's going to look…"* And *"It's repetitive. You take what you learned and then you go ahead and put it together into something of your own"*.

According to the students' opinions, feedback is well designed and it was helpful and encouraging that information was given in the beginning of a task, then an opportunity to solve the problem and finally feedback if needed in the end. This process iterates which according to the students is very good.

Thus, it could be drawn from the interview responses that the quality of the feedback regarding the programming tasks were indeed satisfactory. Further, the feedback regarding students' individual study-progression was also satisfying. It is of interest to highlight student's comments that indicates the importance of motivation in a self-learning system; *"It is good to get clear feedback in percent how much you have done. It's motivational. You want to get closer to 100%. It is also an advantage that the first thing you see is the % of what you have done".* Those comments indicates the system's effect on students' motivation but also the need to go further.

The system was also experienced as very well structured by the students, but the transparency of the chapters could be improved. The students stated that only the subchapters are viewed currently in the system, but that it would be good to see all the chapters at the same time.

Concerning the related fora, which was perceived as satisfactory was at the same time difficult to detect. Two out of three students did not discover the forum. However, the third student used it a lot. Thus, improving the forum's visibility would strengthen the system. A proposal for improvement was given which was to receive a notification about looking in the forum, while receiving an error message associated with a task. The notification should not be received immediately but as they expressed: *"maybe after three error messages – a notification to check the forum could be received. It is good not to be directed to the forum directly, but to try to solve the problem yourself a few times first".* Interviewees found that it was a disadvantage to not be able to click through the system to see what tasks was left to perform.

**Table 1**. Most important design factors

Finally to answer the research question, the most important factors in the design of virtual learning environments for self-learning are found to be:

| | |
|---|---|
| Usability and user-friendliness | Unambiguous exercises |
| Clear and well-formulated feedback | GUI design and multi-modality |
| Gamification | Curriculum alignment |

## 6. Conclusions

Findings confirm that the idea of using additional online environments for self-learning is sound and useful for programming education. Learning to program is more than theory and knowledge and it is valuable to find new online environment for the self-learning that always has been an important part of programming courses.

However, students in N-generation or the Digital Natives that now are entering university programmes are used to high quality graphics and user-friendly design and virtual learning environments for self-learning need to be well-designed. As a result of the conducted study the following important design factors have been identified:

- **Usability and user-friendliness**: environments must be easy to use to keep the main focus on the learning of programming concepts and not on usability issues.
- **Unambiguous exercises**: exercises should be difficult, but regardless of subject they need to be unambiguous (Wiggins & McTighe, 2005).
- **Clear and well-formulated feedback**: programming is a domain where it is easy as well as frustrating to get stuck. Feedback must be well-formulated to maintain the learning flow.
- **GUI design and multi-modality**: digital natives or students in the N-generation have high demands when it comes to graphical design and multi-media. Multi-modal design would also facilitate for students that not are in the category of visual learners (Gilakjani, 2011).
- **Gamification**: the use of gamification is not always the solution (Olsson, Mozelius, & Collin, 2015) but if used with care it can be a strong motivator in digital contexts.
- **Curriculum alignment**: to achieve specified learning outcomes curriculum alignment is a key issue. This is a strength with the MPL system (Mozelius & Olsson, 2015).

There are large variations in students' attitudes toward the two compared online systems, but a clear majority prefers to use the Codecademy environment that have implemented more of the important design factors that are listed above. Interesting extensions of user-friendliness would be programming activities with multi-lingual descriptions and if the online learning environments might be adapted for students with different learning styles. The MPL environment seem to work best for the so called analytical learners (Feldgen & Clua, 2004) and that global learners are more attracted to use the Codecademy system.

## 7. Future work

It would be interesting to further explore a more design-oriented and multimodal design approach for online learning environments. Since the communication patterns have changed drastically compared to earlier student generations there is definitely a need for finding new design concepts for self-learning in digital environments, not least for programming courses.

Another interesting track would be to investigate the importance of mother-tongue in problematic learning like programming education. Several of Codecademy's online courses have been translated to French, Spanish and Portuguese (TNW News, 2014). Today most university students have good English skills but when it comes to more technical descriptions and explanations they have easier to understand if they are given in students' mother-tongue (Pierce & Robisco, 2010).

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# Personal Digital Video Stories: The Live Image as Engaging Reflection Tool in Vocational Educational Training

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**Abstract:** The drop-out rate among students attending vocational training institutions is higher than for other forms of education at the same entry level (in Denmark, but also generally in Europe). A recent Danish reform has aided students, who enter the first part of the basic program directly from primary school. However, there remains a high risk for older students, who do not come directly from primary school; and there is a risk of becoming 'school-weary' (in its broadest understanding) in the periods between school and company practice. This paper introduces experiences with students own digital multimedia and video productions in Vocational Educational Training (VET). These video productions focused on the subjects of their future profession, and increased students' motivation and experience of professional pride. Through a semi-structured literature review, the paper then argues for a research agenda focusing on video productions in combination with digital storytelling, followed by a presentation of the digital storytelling features. The paper concludes with a suggestion to initiate research in what is identified as Personal Digital Video (PDV) Stories within longitudinal settings, while students are at school and in practical placements with companies. This may increase students' social engagement and interest in the subject matter, together with greater awareness of professional identity, which could help decrease drop-out rates for vocational training.

**Keywords:** personal digital video stories, vocational educational training, video production, digital storytelling

## 1. Introduction

"Allan in the back row has dropped out. Without a message to the school, he stopped coming. He did not understand the subject" (Simmel 2010, p. 109, translated from Danish). Many young people struggle to make sense of their vocational training. They experience social challenges and have difficulty in getting the theoretical and practical parts to meet. Some are particularly vulnerable, are tired of school, and feel they are forced "to school" by the Danish legislation that requires youths to have an educational plan; or they lack support from home, and so forth. At the same time, many youths at 'the other end of the spectrum' do not feel they are sufficiently challenged, academically and professionally. They too may experience declining motivation and lack of engagement in their education. During late summer 2016, two meetings were held with Vocational Educational Training (VET) schools (the school *EUC Syd* in the southern part of Denmark and the school *TEC* in the capital area), which confirmed this picture. Consequently, both groups of students (those who find the subject and profession difficult, and those who lack intellectual challenges) are vulnerable and at risk of dropping out.

The intention is not to paint a bleak picture —there are also many students who do well and thrive. Nevertheless, the drop-out rate among students attending Danish vocational training institutions is quite high compared to other educations at the same entry level: approximately 50% in 2014 (Cedefop, 2014) compared with 15–20% for ordinary and commercial colleges, etc. (MBUL, 2015). This trend applies across Europe (OECD, 2012); consequently, research into educational drop-out is a high priority in the EU, particularly in light of the Europe 2020 goal of reducing early school-leavers to less than 10% (EU, 2011). Therefore, despite recent reforms, approaches to the 'school-weary' (in its broadest understanding) still need to be addressed. As in many educational contexts, IT-based learning designs are discussed as a promoter of learning; however, in vocational training contexts (in Denmark, at least), many practical designs are implemented based on experiences from k1-12 school research rather than research-based designs from VET contexts (Riis 2016). This paper presents preliminary findings from a VET context, which support a research agenda focused on students' Personal Digital Video (PDV) Stories.

## 2. Vocational educational training — the system, the students, and the need for grounding reflections

VET in Denmark employs the dual training principle, wherein students alternate between periods in school and training placements within a company. As such, the company makes a contractual agreement to accept a student as an apprentice, and the alternating 'sandwich structure' aims to ensure that the "apprentice acquire theoretical, practical, general and personal skills which are in demand by the labour market" (Cedefop, 2014, p. 4). This alternating training model is particularly used for IVET (Initial VET, a concept used for people who enter the vocational training program prior to having been established in a job function, although workplace retraining is also common, see EQAVET (2016)). During summer 2014, a reform act was passed (commencing during the summer 2015 intake) to make the Danish VET system more attractive, including simplifying the structure, and introducing a requirement that students must achieve passing grades in Danish and mathematics at primary school level. The reforms also aim to reduce the drop-out rate, from the current 50% to achieving 67% completion rate in 2025 (Cedefop, 2014).

The reformed system retains the dual training principle, and hence there are still many transitions, not only between school and company, but also within school, such as between the basic and the main program. The reform introduces an additional transition, as the basic program is divided into two components: The first part (6 months) is for students, who come directly from primary school. At the end of the 6 months, they choose one of four lines of profession: Care, health, and pedagogic; Office, trade, and business services; Food, agriculture, and experiences; or Technology, construction, and transport. They then progress to the second part (6 months) and are joined by older students who finished their primary education more than one year previously (UVM 2014). Upon completion of the basic program (which ends with a test), the students choose a specific education (as carpenter, CNC-technician, cook, etc.) and find an apprenticeship position. In the three-year main program that follows, the students alternate between the company and school. The hope is that a more homogeneous group during the first half-year of the basic program will promote higher completion rates, as confirmed by the results of the first half-year of the reform (Møller, 2015 and UVM, 2016). However, analyses by the Ministry of Education (UVM 2016) and the discussion with the two previous mentioned VET schools (EUC Syd and TEC) suggest that there are still challenges with the more heterogeneous group in the second half of the basic program. When the numbers from the Ministry of Education were published, Stine Vrang Elias, chairman of the Council of Basic Vocational Education, stated: "Therefore, it is pivotal that all parties in the sector […] continue to focus their attention on developing the Danish VET, so that they can attract and retain the skilled young people and equip them for the labor marked with the increasing complex qualifications" (Vrang Elias, 2016 – translated from Danish).

However, not only professional qualifications are at play; social skills also play a significant part. In a study of 379 drop-outs from youth programs, where 106 were from vocational programs, more than half pointed to bullying, followed by fear of school failure leading to low self-confidence and satisfaction. It was concluded that: "This leads to sporadic absences that become more and more frequent and eventually lead to a drop-out status. Apart from social exclusion and school failure, participants in the study directly link their drop-out status to the lack of meaningful support from their teachers, to low teachers' ability for inspiration, to the lack of practical subjects in the school program, to wrong decisions about their education, to serious problems at home and more" (Tsalapatas, Alimisi & Heidmann 2014, p. 43).

Danish research prior to the reform identifies the dual training principle itself, and particularly the school/work transitions, as sources of learning challenges. Firstly, the program structure means that students frequently need to move back and forth between different contexts and in various individual tempi. The unresolved question here is: During their education, how can students create communities and develop a feeling of belonging and being part of a youth culture? (Brown, Louw & Katznelson et al., 2011). From a student perspective, the structure also makes it difficult to establish relationships, and the experience of 'one whole education' is challenged. The fundamental issue is that students do not experience or understand the relationships, particularly between school and the practices of their company, and find it difficult to create links between the different learning contexts during their training (Sjøberg et al., 1999; Aarkrog, 2007; Nielsen, 2009; Jørgensen, 2009). Another associated challenge is about how students first and foremost identifies with the need for practical competences and often lack a basic understanding or explanation of the meaning of theoretical learning in school compared to their professional apprenticeship (Tanggaard, 2006; Koudahl, 2007; Hansen, 2010). This means that students' motivation is often linked to practice, and to practice-based learning at the workplace, while they are less motivated to participate in school activities.

## 3. Digital video production at VET — learned potentials and challenges

Digitalization happens everywhere, also in VET, where examples of video productions are also found. Hansen and Brodersen (2015) describe two uses of video production in the training of a dental technician and an auto mechanic. The examples show that teacher presentations, recorded on video, can be used meaningfully for student differentiation. However, the authors warn that video clips must not replace the teacher and personal feedback. The present study of this paper focuses on another type of video production, namely student-produced videos. These experiences stem from a research and development project in which one of the authors (Rikke Ørngreen) assumed a research-sparring-partner role for a wide range of VET school-based activities during 2011–2012.

An example of this activity is that students training to be cooks took photographs of their preparation of a recipe, to be edited into a photo montage with annotated text (Figure 1). The discussion with the researcher showed that some students were poorly engaged, and often arrived late or not at all. The teacher agreed to try this assignment with some of these students. In this process of students taking pictures, the teacher was surprised to find that the students began correcting each other, with phrases such as, “hold the knife like this” or “you know [name of teacher] always says we should…”, which the teacher had not previously heard from these students. The teacher also felt that the students appeared to have greater pride in their work, both in the photomontage and while cooking. The teacher reported that students spent more time on the lesson and in subsequently editing the production. In an interview with the researcher, a student remarked that the editing process was: “better than the long written reports – I really don’t like writing.” Lastly, it was felt (even among the students themselves) that it was an achievement for the students to attend school at all. The interview showed that the students perceived the process as creative, and that it supported a meta-level of reflection (reflection on the actual task, on themselves, and their roles in this profession). Furthermore, the teacher remarked that the student with the highest absence attended school on time the following day.

The research and development project conducted experiments using various digital and interactive productions among, for example, electricians (Figure 1) and agricultural and business school students. These small experiments showed great potential, but also that such momentum may be difficult to sustain in the long term. For example, one of the teachers asked: “What do we do now; is this something that we keep on repeating; for how long; and every week or sometimes?” Conversely, the previous section demonstrated that the reasons for VET drop-outs were often related to social issues. The video productions in this project were often carried out in groups, and these groups looked as if they were not only working hard, but also seem to be having “just fun,” with good energy and bonding between peers.


**Figure 1:** Example of video productions by VET students

## 4. Discussion of future steps

The research and development project thus showed signs that the produced videos (comprising video recordings, annotated photos, photo montages, and animations assembled into a digital video) act as a reflection tool that supports the professional thinking and the sense of ‘professional pride’. The process of making the digital video, and later sharing and discussing this with peers and supervisors, is a mediator for engagement, motivation, and supports retention of the subjects depicted in the video.

Due to the students challenges in the dual training principle, it is natural to think a longitudinal perspective into the use of video productions, which seem to support social engagement and theory-practice reflections needed. The dialogue with the two VET schools, shows that it would be adequate to think the video production use into the VET's existing portfolio thinking. On the other hand, it is also important not to overdo such approaches, as there is a risk of both students and teachers tiring of the method. Another of the authors (Arnt Louw) investigated VET students' use of logbooks / portfolios, which showed that: "... it is absolutely essential for the results, that the process directly involves students as much as possible, so they develop ownership of the project and that nervousness to participate is minimized" (Louw, 2015, p. 15). From research in longitudinal use of e-portfolios at university level (which used a mix of written and multimodal productions), it was found that ownership is an issue even if students were involved fully into the process of making the portfolio. The research points to that, if the e-portfolio was either mandatory or had to be submitted as part of an examination, then students did not necessarily see the e-portfolio as their own, even if they made it. Furthermore, even if the process showed clear signs of supporting reflection, theory, and practice building, the students doubted whether the produced content was 'good enough' or 'academic enough' when the content consisted of audio or video files. In contrast, students newer raised similar doubts about written submissions (Ørngreen, 2009).

To move the process forward, the digital storytelling approach was examined in order to use digital video productions constructively and meaningfully over longer periods; with different roles, ownership on several levels; and in a process that supports the social and professional spheres as well as theory/practice relations.

## 5. Digital stories as a catalyst for social engagement, professional dialogue, and reflection

Digital Storytelling (DS) centers on constructing personal narratives through the use of multiple digital media and modalities, including images, voice, music, video, and animation. The method was originally developed in the United States in 1993 by Joe Lambert and Dana Atchley, who aimed to give marginalized groups a voice through the use of bottom-up activities, applying user-driven practices (Lambert, 2013). The Center for Digital Storytelling opened in Berkeley in 1993, and has facilitated more than 1000 workshops (Lambert, 2013). The method has since been established and used internationally (e.g., Hull & Katz, 2006; Lundby, 2008; Hartley & McWiliam, 2009; Davis, 2011; Luttrell, Restler & Fontaine, 2012). A number of DS projects (particularly in Australia, Denmark, and the UK) focused on the involvement of various groups, with the objective of giving them a voice in society, allowing for reflection on their own practice and professional identity, and support for relational work (Hull & Katz, 2006; Taub-Pervizpour, 2009; Podkalicka & Campbell, 2010; Luttrell et al., 2012; Hardy & Summer, 2014; Jamissen, 2015). Additionally, several studies show that the method can develop collaborative skills, mastery of multimodal digital technology, self-knowledge, self-representation, learning and reflection (Alterio, 2002; Barrett, 2006; Haug et al., 2012; Jamissen, 2015).

The method consists of different phases: identification and building of one's own personal narrative; a multimodal production phase; and various collaborative process by which participants find their central narrative, which is then communicated in short digital videos, that are self-produced but with professional assistance. The work on narratives offers participants an opportunity to explore, understand, and link their past experiences with current situations and future envisions, focusing on the various associated feelings and thoughts (McKay & Ryan, 1995; McCorquodale & Kinsella, 2015). The DS process has the potential to create meaningful bridges between participants' personal and professional lives (Walters, 2014; Haug et al., 2012). The personal dimension of the method opens the participants to 'see themselves in the mirror' through self-representations (Lundby, 2008) and also acts as a bridge in a community. For example, personal perspective gives the stories identity, and the participants are brought into each other's realities when the stories are shared in the so-called "story circles" (Haug et al., 2012). These digital storytelling/sharing sessions are seen as supporting social reflection, learning processes, and the development of a community of practice (Fletcher & Cambre, 2009). The multimodal dimension of the method, working with text, sound, and images, allows participants to access and explore their experiences and ideas from different angles; and may support students with reading/writing challenges, as they can surpass the limitations of those formats and engage fully in reflection and production processes (Gythfeldt & Ohlman, 2012).

The DS method also includes challenges that need to be explicitly addressed. For example, studies show that participants in educational institutions (both teachers and students) may be resistant to 'exhibit' their own personal and private sphere in the DS phases (Ribeiro et al., 2014; Lundby, 2012). Also, tension can arise when the participants' stories do not match the organization's strategy or do not confirm the 'wanted' tale (Haug et al., 2012). If the personal dimension is absent or the institutional strategy is over-emphasized, there is a risk that the results become pure information videos that fail to fulfill the potential of the method for including identity development (Haug et al., 2012). However, in a DS study of university students and teachers, the process increased interpersonal relationships and empathy among the participants, despite their initial opposition to the personal dimension: "This process fosters opportunities to connect and deepen relationships between students and teachers and amongst students" (Ribeiro et al., 2014, p. 184). This emphasizes the importance of the facilitator's awareness of possible risks in a DS-process, which are similar to the aforementioned experiences from the VET logbooks and e-portfolio projects.

## 6. A research agenda: Personal digital video stories in VET — or simply: PDV-stories in VET

It is argued here that the DS method is supportive of social engagement and provides a space for professional dialogue through a process that is very democratic. The results from the development and research project at Danish VET educations show that the involvement of teachers in the video production helps both parties to gain a good understanding of each other; and at the same time, because the process is motivating for the students, a better theory/practice balance can be achieved.

The inclusion of company supervisors may help alter the assumption that: "Nowadays, it seems that there is a general agreement that schools fail to promote the value of education and the value of active participation in the school community. More and more students (regardless expression of drop-out tendency) describe themselves as 'tired' by the school system" (Tsalapatas, Alimisi & Heidmann, 2014, p.44).

There are reasons to believe that video production exercises may better achieve their potential when teachers and company supervisors participate in some of the actives. This participation could provide a basis for understanding each other's expectations and environments. It is therefore suggested that future research examines what can be termed Personal Digital Video Stories (PDV-stories).

There is a need to systematically develop, test, and verify sustainable educational designs that make use of personal digital video stories within the second basic program, and in the transitions between school and practice. It is suggested that PDV-stories, used repeatedly in smaller segments (e.g., 2–3 days in a week) throughout the second basic level and during periods of practice in companies, may support students and their willingness to continue. The PDV-stories can be used in both physical presence processes when students are attending school, and in online distributed processes during their company placements.

## 7. Conclusion

The paper has shown that drop-out rates are high in the VET context, particularly during the second part of the basic program and in the main program. Specifically, students experience difficulties with theory/practice relations, and alternating between periods in school and company placements. Based on experiences from video productions used in a Danish VET setting and from Digital Storytelling, a combination is suggested, framed as Personal Digital Video Stories (PDV-stories).

The objectives of the envisioned PDV-stories are to:

- Increase social engagement, professional identity, and reflection on professional knowledge;
- Provide clarification in the theory/practice dimensions, and a better match between the school and company placement periods;
- Thereby encouraging students to complete their training programs and decrease drop-rates.

For these objectives to be achieved, research is needed to systematically develop, test, and verify sustainable educational designs that make use of personal digital video stories in VET.

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# YouTube: A Vehicle for International Collaboration

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**Abstract:** Technological progress in society is advancing at a phenomenal rate; arguably, education is struggling to keep pace (Martinez & McGrath, 2014). In modern classrooms educators have powerful technological tools available at their fingertips and although there are many examples of innovative uses of these tools (education world, 2015), overall their application is erratic and sporadic at best (Rittel, 2012). One of the reasons for this lag may relate to the pace of technological change itself (Martinez & McGrath, 2014). The latest technological advancements become obsolete before they make it into the classroom, or before their potential for educational application has been tested. Specialist educational software, social media platforms, simulation platforms and hardware all fall within this category. However, there are some advancements that have stood the test of time, thus far. Within the realms of education YouTube is often seen as a resource, an audio visual library or an avenue to showcase educational outcomes (Dunn, 2011). However, it is seldom used as a collaborative tool. This is where it may offer the biggest potential. This paper proposes to explore this potential through a planned international collaborative project involving second year bachelor students, from the United Arab Emirates and Mongolia, undertaking an Innovation and Entrepreneurship course. Between April and May 2015, students in both countries posted short videos of their business ideas on a private YouTube channel, administered by faculties in both countries. Using a qualitative approach this paper assesses the usefulness of YouTube in facilitating an international collaboration project of this nature. Exploring the potential of YouTube as a tool for facilitating international collaboration may help rebrand its educational application. The fact that YouTube is readily available and easily accessible can also provide new opportunities for a large number of students and teachers to engage in international collaboration.

**Keywords:** You tube, international collaboration, United Arab Emirates, Mongolia, higher education, innovation and entrepreneurship, qualitative approach, usefulness of YouTube as a tool

## 1. YouTube: A vehicle for international collaboration

Technological progress in society is advancing at a phenomenal rate; arguably, education is struggling to keep pace (Benson, 2013). In modern classrooms educators have powerful technological tools available at their fingertips and although there are many examples of innovative use of these tools (education world, 2015), overall their application is erratic and sporadic at best (Rittel, 2012). Successful integration of classroom technologies that offer the latest innovations require technologies that are accessible and fit for a range of educational purposes. This is especially true for this study as will be identified later. However, above all these technologies must have an in-built capacity to evolve and offer longevity. This element of longevity helps support a crucial element within the educational process of trial and error. Optimal use of resources is often achieved through the experience and learning process of application and evaluation. Arguably, YouTube offers such an opportunity for educators, accessibility certainly being of important within this study. However, within the realms of education YouTube is often seen as a resource, an audio visual library or an avenue to showcase educational outcomes (Dunn, 2011). It is seldom used as a collaborative tool for the international stage. This is where it may offer the biggest potential, collaboration between colleges anywhere in the world.

This paper explored the potential through a planned international collaborative project involving second year bachelor students, from the United Arab Emirates and Mongolia, undertaking an Innovation and Entrepreneurship course. Between April and May 2015, students in both countries posted short videos of their business ideas on a private YouTube channel, administered by faculties in both countries. The authors of this paper decided to collaborate on this paper when they discovered that they would both be teaching the same module, innovation and entrepreneurship, at bachelor level but in two different countries, United Arab Emirates and Mongolia. The initial idea was for students in both countries to share their innovative ideas with each other using a social media platform. In addition to YouTube, tools such as Voicethread, Facebook, Sgrouples and Skype were also considered. The platform needed to be available in both countries and to all parties. There were the additional elements such as accessibility, distance and time differences, cultural and religious complexities. The authors understood at the time of the study and still realise that using YouTube was not pushing the boundaries of using social media as a tool for educators, but some of the tools initially considered had to be eliminated because they did not meet the additional element restrictions.

Therefore, the YouTube private account seemed to meet all the additional elements stated. YouTube has other benefits such as being a technology that it is popular with different age groups, it offers a comment posting facility that could be used by all parties, which was a necessary part of this collaboration exercise. The study adopted a qualitative approach and used focus groups to collate the experiences of students at each site separately.

## 2. Literature review

"Social networking is transforming human communications and interactions" (Smith, 2009 cited by Cheal, Loughlin and Moore, 2012 p.8). This quote sums up the focus of this study, until such tools were available, collaboration between two such countries would have been difficult if not impossible. This research proposed to use social networking tools across continents and countries in order to create forums of communication and interaction unachievable without Internet based social networking tools.

Much has been written about using technology in the classroom and the innovative use of these tools (education world, 2015). In a report for the Higher Education Academy Mackinnon (2013) provides an analysis of five separate case studies exploring the use of social media platforms as learning tools. In all instances Mackinnon (2013) found students seamlessly adapted to a diverse range of platforms, such as Facebook, YouTube and Twitter. However, students are not the only stakeholders within the classroom, be it virtual or not. Teachers are often the main instigators of incorporating technology into the classroom. In a study of technology readiness of teachers in Bahrain, Khine (2011) found high levels of teacher familiarity with YouTube. YouTube ranked highest with 38.2% compared with 27.3% for Facebook and 12.7% with Wikipedia (Khine, 2011). This suggests YouTube is the most likely technology to be used in the classroom because teachers are comfortable using it. However, as Roodt and Peier (2013) suggest, given the needs of modern learners today YouTube needs to move beyond the traditional application of a video library, which by 2016 the researchers felt YouTube had moved forward.

Greenhow and Robelia (2009) detail four benefits of using social networking in education:

- Providing students with social, emotional and cognitive support
- Challenging students to express themselves
- Fulfilling various social learning functions through collaboration and students
- to like-minded learners.
- Building students' communication and technology skills and understanding
- from different points of view.

In regards to international collaboration Usen (2003) suggests the usefulness of Internet based social networking tools to higher education because of their potential to connect geographically diverse participants. Platforms such as YouTube can potentially facilitate and promote international co-operation, the exchange of ideas, opinions and information (Mackinnon, 2013). These were some of the objectives of this research, using a platform to cooperate on the same topic internationally, being able to exchange opinions and share information with colleagues and fellow bachelor students based in another country but working on the same topic. Molebash (1999) provides details of such collaboration at the Centre for Technology and Teacher Education at the University of Virginia. Live video connections with partner universities brought together professors and students in a forum where all parties contributed and benefited from the collaborative learning experience (Molebash, 1999). In this papers' collaboration the two sets of students and the lecturers collaborated separately. This was felt to be more beneficially than potentially confusing students with input from two different lecturers in different time zones with input styles geared to their target audience.

## 3. Research methodology

In line with Cheal, Loughlin and Moore (2012) this study adopted a qualitative approach using focus groups. The main aim was to explore whether YouTube was an effective education technology to facilitate international collaborative learning strategies given the imposed limitations of the countries such as censorship and privacy concerns. In order to better understand the usefulness of YouTube in this context the study focus on the following questions:

- How do student perceptions vary on the use of YouTube
- How do students perceive this as a learning exercise

In applying such a methodology there is an assumption that students will seek to understand the experiences they have had with using a new approach and therefore become useful informant in constructing meanings to develop a better understanding of the phenomenon (Creswell, 1994). As suggested by Cheal, Loughlin and Moore (2012) the focus group was planned three to four weeks after both sets of students had created and uploaded their videos. It was thought that this approach would be particularly useful as it allowed both sets of students to view videos with fresh perspectives after the intensive input, idea design and video creation. This was especially true in the case of the UAE group as due to cultural reasons the female students used animation and tubechop to create their uploaded videos. The Mongolian group on the other hand recorded themselves using an Ipad and then uploaded their videos. These differences obviously reduced the reliability of the study but the focus questions were aimed at student perceptions of Youtube for the exercise and as a learning tool.

The focus group collaboration suggested by Cheal, Loughlin and Moore (2012) took place after all students had finished reviewing and commenting on the videos. Due to the initial size of the groups, and in contrast to the large focus groups used by Cheal, Loughlin and Moore (2012), the study aimed to conduct 2 focus groups of 3 to 6 in each country. In actuality the focus group in Mongolia comprised 6 students and in the UAE, 6 students. Even though the focus groups were small the authors were able to gather direct quotations which according to Creswell (1994) are essential to qualitative study. The direct quotations allowed the authors to gauge whether this cross country collaboration had given the students a useful learning experience. Both focus groups had the objectives of:

- How do student perceptions vary on the use of YouTube
- How do students perceive this as a learning exercise

## 4. Summary of focus groups

The Mongolian focus group had 2 males and 4 females. The students were initially reminded of the research question, "Is YouTube an effective education technology to facilitate collaborative learning strategies?" Then the two objectives of the study were written on the board as sub questions with the facilitator asking the students to think for 10 minutes about these two questions. The focus group responses can be seen in appendix 2 with the main prompts and two additional inputs from the lecturer.

The students in Mongolia perceived YouTube as a useful tool or platform on which to show their business ideas and that it was a useful learning exercise in order to get feedback from someone they did not know. They felt they made more effort in the recording and putting the idea across on YouTube. The students concerns or the limitations to this exercise were their level of English and that some of them wanted immediate responses which unless Mongolia was teamed with a college in Russia or China there is always likely to be a time difference.

The UAE focus group had 6 female participants. In order to enhance validity both focus groups followed the same approach. The UAE participants were firstly reminded of the research question, followed by the two objectives of the study being written on the board as sub question. The facilitator asked the students to think for 10 minutes about these two questions. However, the seven questions or prompts were specifically covered whereas in Mongolia there was a general brainstorming and discussion with the questions or prompts being used to make sure the group was on track.

The students in the UAE focused more on the problems encountered than the Mongolia students for example the problem of uploading their comments, the shortness of the videos and needing to listen many times because of the English, and benefit of using video. However, like the Mongolia students they thought that YouTube and the exercise were useful and beneficial. They also found the comments useful because these allowed them to change parts of their project. Watching the pitches of Mongolian students also helped UAE students better prepare for their final exam. The students would have liked more contact with the Mongolia students but with time differences that would have been difficult. However, overall all UAE students found this exercise a valuable experience and something they could put on their CVs.

All students found the experience of recording their business ideas and uploading to YouTube a valuable and interesting exercise. Students in Mongolia and the UAE had reservations about their English levels but found ways of overcoming this by listening many times to the videos and practising before finally recording. There were differences in the expectations and attitudes of both sets of students which may have had an impact on the project. For example, these students were chosen because of the courses they were undertaking and no other similarities were considered. The UAE students were in semester 4, whereas the Mongolian students were in semester 8 of an 8 semester course. This difference in the year of study may well have determined the students' expectations and attitudes.

There were other minor yet observable cultural differences between the two sets of students which may have affected the project. For example, Mongolian students expected faster turnaround time on receiving comments after they had posted their videos. Comments were delayed first because of a technical glitch and then because some of the UAE students were late in posting them. Therefore, project outcomes below expectations may have affected levels of motivation amongst students. UAE students had different issues to contend with. Due to cultural and religious reasons the UAE students did not want to share their business ideas via pitches. They overcame this by not appearing personally in the videos and developing short animations instead. However, this also meant that UAE students took longer to add their videos onto YouTube. The lack of technical expertise in using different aspects of YouTube amongst facilitators and students was a reoccurring theme and something that needs to be considered in future projects.

## 5. Discussion

It is noteworthy that even though YouTube is considered an old educational tool for these students, whether in the UAE or Mongolia, using YouTube as a collaborative tool was for the first time. This suggests there is scope for further exploration of how these tools can be used to advance collaboration between students in different school, cities and countries. Despite issues with access and usability students were able to adapt and take part in the project. For example, there were issues with leaving feedback comments. The comments were an integral part of this project because students were expected to develop their idea according to feedback from their counterparts. But students also wanted these comments to be out of the public domain remaining a private group. This meant that each student had to be given admin rights, individually, which in fact was the main reason for the delays. This also highlights short comings in the facilitator's ability to use YouTube and limitations of YouTube itself. Nevertheless, most students overcame this setback to participate in the project. This enhanced motivation to participate in the project demonstrates that students like the idea of collaborating across borders and adopted YouTube well as a means to achieve these ends.

Students' reluctance to leave comments or receive them, because they did not know the other group at the beginning of the project was another issue which was not really that obvious at the offset. Student age, gender, culture and indeed the nature of the project may also have contributed to this factor; however, these assumptions would need further investigation. Nevertheless, future projects need to take these issues into consideration. Although none of the students specifically mentioned learning, over all students saw this as an interesting method of learning. They were excited by the prospect of working with international students and saw the short and long term benefits. As expected the comments function was highlighted as an important tool. However, the video player and the fact that students could view the videos again rewind them and play them at their own pace, were also highlighted as an important tool. Language was expected to be an issue on both sides as English was a second language for both sets of students. However, it would seem the YouTube can help overcome this issue, to an extent, because by controlling the pace of the video and maybe how and where students watch the videos arguably enabled them to understand and form their own opinions of the videos.

Arguably, the most interesting aspect of the project was the nature of learning. It should be pointed out that most of the work on this project was done outside the classroom. Students formed their initial ideas in a classroom setting. However, these were turned into videos and uploaded onto YouTube outside the classroom. Students watched each other's ideas and left comments outside the classroom. Indeed they took control of their learning experience, controlled the pace of learning and ultimately took responsibility for their participation. Although they were collaborating they formed their own understanding and judgements of the business ideas independently. This would suggested that the enhanced motivation students demonstrated went beyond the novelty of using technology, that they were familiar with, in a different way. Arguably, it was the freedom, flexibility and security that YouTube provided to students that captured their interest and motivated them to participate and adopt the method of learning facilitated by this project.

## 6. Recommendations and conclusion

Overall both researchers found positive comments and encouragement to try the project again with other students and potentially other subjects. The students' suggestions of pre video introductions possibly via a blog or some form of secure area could be introduced. If this project was undertaken again the researchers could make the request that students comment on all videos or give feedback in 2 or 3 predefined areas such as: interesting/exciting; potential of idea in another country and viability of idea. Many be future projects of similar nature and in similar contexts should stipulate the use of subtitles this would have learning benefits for both students. This also represents opportunities to integrate literacy skills in the project. This point has been covered in the earlier question. Students enjoyed this project and method of learning. Interestingly, students highlight the need for some sort of orientation – where they would have got to meet the other students and may be better understood expectations. These elements should be included in future projects.

## Appendix 1

**Focus group Questions**

| Research Question | Sub Questions | Focus Group Questions / prompts |
|---|---|---|
| Is YouTube an effective education technology to facilitate collaborative learning strategies | **How do student perceptions vary on the use of YouTube** | Q1.What was it like to work on YouTube in this way? What were the good / bad points? |
| | | Q2. Which functions were useful, which were not? |
| | | Q3. Over all did you enjoy the experience? Y/N why? |
| | | Q4. Which other classroom technology could we have used in this activity? |
| | **How do students perceive this as a learning exercise** | Q5. Were you able to understand the business ideas? Why / how? |
| | | Q6. What did you think about the feedback process? Was the feedback useful? Yes / no why? |
| | | Q7. Do you think receiving and providing feedback for improving business ideas will help improve your business plan? |

**Comments from Focus Group in UAE**

**6 UAE Students in focus group, > (FI), (SO), (MM), (MAM), (AA), (MS)**

Q1

SO: It was interesting because it was different. But it was also difficult in the beginning because we had issues with logging on and leaving comments we were shy about uploading our videos as well because we did not know what the Mongolian students would think about our videos.

AA: yes it was a bit weird letting strangers see our videos even though we were not in them it was scary to see what they would think.

FI: It was exciting for me because we were working with student so far away… it would have been better if we did the project together.

MAM: it was difficult to watch and leave comments for each video… the videos were quite similar and my feedback was quite similar for each one…. I hope they did not mind… some of the comments were quite useful and it made us think about how we can make the business different. It was good that we did our videos in animation and they did presentations – watching the pitches helped us with our finals as well… I said to myself I can do this… change this thing…. Add this thing…. Like that.
MM: this also looks good in our CV – that we have worked in international project

Q2

FI: once the comments started to work it was quite useful… the video player was also a good tool because it allowed us to play the videos again

AA: yes this was a problem I could not understand some of the students so did not leave feedback for them…
FI: it would have been good to have chat function so we could communicate as we watched the videos.
MAM: yes the comments and video player were good. I used the like button as well… but not sure if that means anything.

Q3

SO: Yes it was good but as I said it was also a bit scary…. I think if we knew the students a bit more then it would have been good.
AA: and the comments function did not work in the beginning which delayed us.

Otherwise all in agreement that it was an enjoyable experience.

Q4

FI: we should use the smart boards in the classrooms and make a presentation about us our college.
MS: can we use skype or something like that to have both our classes meet and introduce our selves… like we do in the first of the semester if there is a new teacher…

Q5

FI: this was an issue because I could not understand most of the presentations… so ok the presentation was only 1 or 2 minutes but I had to listen to it so many time to see what they were saying… but I got most of them in the end…

SO: it wasn't too bad – we had similar ideas when we were brain storming so it was not too difficult to pick up… just the English was an issue but youtube was good because we could play them again and come back to it again…

MM: so of the ideas were very good and we could use them in the UAE. I would like to visit Mongolia to see what it is like there…the theme park idea is similar to the theme parks being built in Dubai…
Most of the group acknowledged they would like to visit Mongolia

Q6
AA: I did not leave too much feedback because I did not understand the presentations I listed to 1 for a few times and understood it a bit and leave some feedback…
SO: I did not read the email about which points to cover in the feedback so it was difficult to feedback…
FI: also I think I was waiting to see who leaves me a comment before I leave a comment for them…
MAM: the presentations were quite similar and I thought I should leave the same feedback…some of the comments for us were very good because we saw how people from outside the country looked at our ideas… I made changes to my idea because the business is not just catering for Emirati customers… it also has to attract all the expat living here.
FI: I think their comments were good – but not all of got them… it would have been good to ask them what they meant – so the chat function would have been good.

Q7
MAM: yes defiantly as I said I changed my idea and I think now it is more flexible I mean more attractive to different types of customers.
FI: As I said it was helpful to those who got comments.
SO: The best thing was that we got feedback on our ideas from people who were not our teachers and not even in the country… it made us think about the business idea in a different way… improve it… also it helped us think about our finals as well and how we could present our ideas.

The rest in agreement that it helped them improve their business plan.

**Comments from Focus Group in Mongolia**
**6 Mongolian Students in focus group: M, U, B, K, E, C**

M: I enjoyed the experience and found it interesting to get feedback about my idea from people from another country. I think their comments may me think more before I put the idea up on YouTube – like was my idea clear, was I telling people about my idea in a good way so that is was understandable. I don't think I would take so much effort if I was just reporting to fellow Mongolians.

U: I agree with that as I found I was thinking in a more professional way. Also when I looked at the other college's ideas I was more focused but perhaps I shouldn't have only thought if the idea would work in Mongolia as that wasn't really necessary.

C: I was able to follow the ideas and enjoyed the animation used but would have like to see real people as if you are presenting a business idea to a sponsor it has to be in person. So for me this was a negative point, but on the whole I liked the idea of someone from another college and country seeing my idea. I agree with M: it made me consider my presentation more.
E: I didn't really enjoy the experience as I was worried about my English but I suppose the other students may also be worried about theirs. I liked reading their comments and seeing their animations, perhaps we could have done animations instead of presentations.

M: but we don't have the skills – the Graphic students would have had to help us!

B: As I want to open my own business I enjoyed recording my idea and posting to You tube as I could see how to improve my presentation. The feedback was good for me again so I can improve for presenting to a bank. It was good that it was private as I wouldn't want my friends to see and laugh at me!

U: yes you are right can you image some of the other students here seeing the clip and making comments that wouldn't have been professional. Perhaps there could have been a better way – more private?

Skype – video conferencing

E: yes we could have skyped or video but again I would have been nervous and not said anything – isn't there a time difference?

C: I liked recording for the clip as I could keep recording until I was happy with the clip and then upload – skype or video conferencing wouldn't have allowed me to practice. Even facetime would have been immediate – yes I think there is a big time difference

4 hours – Sunday to Thursday

B: so to be live may be difficult to organize – but we could have just recorded and uploaded to an email???

U: But that would mean that the other students would just have to write their comments and email back – I think it is good to have them under the video and it is more immediate – your first reaction.

B: I was worried that my written English would have spelling mistakes so I took my time writing the comments – perhaps that was better as I thought about what I wanted to say.

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# Exploring Digital Didactics: An Explorative Case Study on Learning to Teach Online

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**Abstract:** Online teaching became increasingly popular during the last decennia. Therefore, many teachers face a challenge in combining technology with content and didactical approaches. However, not all teachers have experience with online teaching or the didactical approach towards it. For this reason the 'Digital Didactics' programme is developed in the context of teacher professional development in Flanders, Belgium. 'Digital Didactics' strives to provide teachers with hands-on experiences regarding the didactical possibilities of online teaching. These experiences could be implemented immediately in the teachers' own practice. The programme builds on scientifically supported knowledge on teaching with technology such as the Technological, Pedagogical and Content Knowledge (TPACK) framework. The research question this study addresses is first to investigate the reasons to participate in the Digital Didactics programme, and second how the participants and the coaches are experiencing this programme. Data was collected through qualitative online structured interviews and focus group interviews and analysed by using an inductive approach and thematic analysis. This paper presents the outcomes of the programme and clarifies the identified strengths and challenges of the 'Digital Didactics' programme. There are three main reasons for participation identified, namely: personal, professional and peer related motives. Next to that are the participants' experiences divided into three levels, namely: content level, guidance level and practical level. The experiences of the coaches and participants were found to be similar: they agree on both the perceived merits as well as on the weaknesses of the programme. Conclusively, the study contributes to the knowledge on effective professional development strategies for online teaching and learning. This can be useful for practitioners or researchers in the field of online teaching and related professional development.

**Keywords:** digital didactics, online teaching, teacher professional development, technology integration, TPACK

## 1. Introduction

### 1.1 Theoretical background

Since information and communication technologies (ICT) made their way into education, teachers at various educational levels are more frequently required to teach their courses (partially) online. Besides the fact that teachers need a sound understanding of the nature of their teaching subject, and suitable pedagogical theories and practices (Chikasanda et al, 2013), they nowadays also need be trained in teaching online (Salmon 2011). Providing training on teaching online can enhance teachers' technological, pedagogical and content knowledge (Walker et al, 2012). The concept of this Technolocial, Pedagogical and Content Knowledge (TPACK) has been considerably described by Mishra and Koehler (2006). Mishra and Koehler (2006, p.1017) describe their TPACK framework as follows: "It attempts to capture some of the essential qualities of teacher knowledge required for technology integration in teaching … thoughtful pedagogical uses of technology require the development of a complex, situated form of knowledge … Technological Pedagogical Content Knowledge". Teachers whom are teaching (partially) online should thus be able to know which pedagogical strategy and technology to use, to teach a certain subject.

Online teacher professional development (OTPD) has been originated due to the need for professional development that provides authentic support and that is tailored to teachers' busy schedules (Dede 2006). OTPD that is aimed to enhance teachers' knowledge on teaching online, serves in this matter a dual goal. Not only is the content of the professional development important but also how it is being taught and delivered. This is due to the fact that how it is being instructed – the online delivery mode – is also a form of content. Thus, what is being taught and how it is being taught are in this case both content. If teachers are not trained to teach online or are not prepared for their new role (Redmond 2007), then it could be that they merely will try to transfer their classroom practices to the online environment (Kelz 2011). Additionally, Meloncon (2007) indicates that teachers need to redefine themselves when they are changing their teaching place, e.g. the change to an online learning environment. This stresses the importance and the need for a TPD on learning how to teach online. In this respect, recent research emphasises the need for more studies on effective professional development for online teaching and learning (Philipsen, Tondeur and Zhu 2015).

Training teachers in teaching online implies that the training programme should address adult learning principles. Herrington et al. (2009) argue in this respect that the modules of an OTPD should reflect the principles of adult education. Furthermore, they show that the different modules need to address the current needs of the teachers, and that teachers need to be stimulated to transfer that what they have learned to their own practice. However, recent research (e.g. Watson and McIntyre 2012) still shows that teachers face some barriers when it comes to online teaching, which could impede the implementation of it. Watson and McIntyre (2012) identified for example some barriers related to the lack of time, the lack of collegial support and the lack of relevance. Teacher professional development for online teaching is therefore a complex process of addressing important components in striving towards effective results. How this effectiveness is described, greatly differs between different professional development initiatives. Therefore the local context and needs should always be taken into account, when one starts to evaluate a TPD programme on its effectiveness.

### 1.2 Purpose of the study and the training programme

The presented study aims to evaluate why the participants enrolled themselves in the Digital Didactics (DD) programme and what they expected from it. In this way the researchers can investigate if the participants' expectations have been met. Next to that, this study aims to identify how the participants and the coaches experienced the DD programme. Their experiences are questioned on three levels, namely: the guidance level, the content level and the practical level. The answers on these questions can add to the existing knowledge of effective OTPD for online teaching and identify further research possibilities.

The website of the DD programme can be found at www.digitaledidactiek.be and is available in a Dutch, English and French version. The programme consists of an online linear trajectory with seven modules. The modules are respectively: Basis, Design, Development, Implementation and follow-up, Cooperative learning, E-coaching and finally Concerns. The programme – only the Dutch version – is developed in such a way that there are two participation opportunities. The first one is that participants go through the programme by themselves without any support from a coach. In this mode participants can see all the theory, cases and extra exercises, but they cannot log in on the website nor do they get any support, tasks or feedback from the coaches. It is in the second mode that participants can register themselves for a professional development trajectory with the support of a coach. In this case the five coaches provide tasks for every module and give synchronous (chat, Skype) or asynchronous (mail, forum) support and feedback. The participants and coaches have the opportunity to meet in real life during a kick-off and kick-down moment at the beginning and the end of the programme. The English and the French version offer only the first option, to go through the programme yourself. The current paper reports on a first pilot test of the programme – with coaching – which started in March 2015 and ended in June 2015. The participants were on the one hand pedagogical and didactical experts and on the other hand lecturers in the Flemish vocational education, colleges and a language and communication centre. The programme was free of charge for the participants and the coaches worked on a voluntary base. At the beginning of the programme there were 40 participants enrolled, from which 20 eventually completed the programme. The participants are mixed male and female, and their ages range from 24 years old to 72 years old. There was a slightly higher percentage of females (n= 24) than males (n= 16) and the most occurring age ranges were 25 to 45 years old (n= 14), and 46 to 65 years old (n= 14). The specific research questions (RQ) were:

- RQ1: What are the participants' reasons to participate in the DD programme?
- RQ2: What are the experiences of the participants and the coaches on the guidance level, content level and practical level?

## 2. Method

### 2.1 Data collection and analysis

The data collection and analysis was based on specific questions proposed by the organisation that coordinated the DD programme, namely the Belgian Network for Open and Digital Learning. The data was collected through the participants' answers on qualitative online structured interviews and focus group interviews with the coaches. The participants were asked – through the online structured interview – the same questions after each module to capture their immediate experiences. The qualitative data was analysed using a thematic analysis

(Howitt 2010). This is based on an inductive approach and situated within the paradigm of interpretive research. The coaches' experiences were collected through two focus groups interviews (Patton 2015). One was held halfway during the programme where the role of the researchers was solely to observe the discussion between the different coaches. The researchers did not suggest any discussion topic nor intervened during this discussion. Only at the beginning was a certain discussion topic set by the researchers. In this way the discussion topics and communication originated in a more natural way, albeit that a focus group conversation essentially is not the most natural way of having a conversation (Berg and Lune 2014). The second focus group interview was held at the end of the programme. In this focus group interview the researchers did contribute in an active way by proposing questions and discussion topics. Observation notes were taken during the first focus group and the second focus group was digitally recorded and transcribed using Nvivo 10. Two coding processes were done. First, an open coding (Miles and Huberman 1994) was done were small units of data led to a lot of different codes and which is done to capture the richness of the data. Second, the axial coding (Miles and Huberman 1994) was done to construct larger categories and identify key concepts. The researchers identified and constructed specific themes after the second coding process. All the participants and coaches were informed of the research and signed an informed consent to address procedural ethics (Mortelmans 2013).

## 3. Results

### 3.1 RQ1: What are the participants' reasons to participate in the DD programme?

Stemming from the data all participants indicate that they participate out of their own free will. The participants show three great motives to participate. The first one is out of personal interest, which is not necessarily linked to their profession. This study identified that this personal motivation is very often in combination with professional motives. These professional motives are clearly linked to the everyday practice of the participants. In alignment with these professional motives, these participants expect a certain professional growth. Specifically on their didactical expertise and their knowledge on the didactical possibilities with online teaching. Some participants even make a clear reference to their students. In this case the participants want to know what the merits are for their students and how it benefits them. The following quotes from two participants illustrate these findings.

> *Professionally I would like an overview of the different didactical possibilities offered by the digital world. I am convinced that this is a very exciting world that allows us to guide our students to be self-reliant in their learning and to enhance their intrinsic motivation. I would like to try new things and see in how much this works to achieve my objectives. Personally I just want to be part of this digital era. (Female, age 61)*

> *I enrolled due to professional motives and personal interest: I always experiment with new digital tools and I always try to help others with it. Yet, I still have a lot to learn on how you offer an entire course digitally. There was also an extra motive why I enrolled and this was due to the fact that I enrolled together with a colleague. (Female, age 34)*

As this last quote shows, personal and professional motives are not the only reasons why participants enrol themselves. Although it occurred with only one participant, the possibility to enrol with another colleague is also found to be an important reason to participate. This is placed under peer related motives. In summary, the three main reasons why participants of the DD programme enrolled include: personal motives, professional motives and peer related motives.

### 3.2 RQ2: What are the experiences of the participants and the coaches on the guidance level, content level and practical level?

#### *3.2.1 Guidance level*

The guidance level aims to identify the participants' and coaches' experiences in relation to the received and provided coaching. The participants are asked to comment the general received support of the coach, the amount of feedback, the quality of the feedback and the availability of the coach. This last one pertains to how well the coach responded to their questions in a timely manner. Generally, most of the participants agreed on the fact that the guidance was done very well. All of the four previous mentioned parts – i.e. general support, amount of feedback, quality of feedback, and availability – were found the be very positive and helpful. Specifically, the coaching motivated many of the participants to persist in the DD programme and to complete the tasks. In that way the participants indicated that the coaches had a motivational function and content-related function, where the latter refers to offering new knowledge and skills.

> *One of the strong points of the programme is that you are being coached. You are being motivated to complete your tasks and you actually work on something that you could use in your own practice. (Female, age 41)*

> *Generally, it [the digital didactics programme] went well. The material was easy accessible and the coaching was good. (Male, age 32)*

When the coaches look back at their own role in the DD programme, they indicate that the fact of having a coach is highly beneficial. They predominantly see it as their task to provide feedback and to motivate the participants of the programme. However, they also argue that it is one of their greatest challenges to keep participants motivated.

> *The reaction is really that the coaching is very beneficial. If they would go through the programme by themselves, that would be totally different. We had someone who said that this was the best course ever. (Coach 1, female)*

> *I think that a lot more people would have quit the programme [without the coaching]. That is also the feedback that we get from them. (Coach 2, female)*

The experiences of the participants and the coaches show a great resemblance. Where the coaches see it as one of their main tasks to keep the participants motivated, the participants indicate that the coaches actually succeed in doing so. Nevertheless, there was still a great deal of participants who dropped out of the programme, indicating that coaching alone is not enough to keep participants enrolled in a professional development programme.

#### *3.2.2 Content level*

The content level aims to identify if the content offered within the DD programme is relevant to the participants' practice. Questions at this level focus on how well the content of the programme offered new knowledge, and how well this is aligned with the participants' current knowledge about online teaching. Furthermore, the participants are asked how well they would be able to implement this new knowledge, skills and tools in their own practice. Generally, the participants see the programme as relevant for their own practice. They indicate that relevance mainly comes from an alignment with their current professional needs and their institutional context. This means that when the participants are faced with an institutional transition towards more online teaching, they indicate that the programme is highly relevant for them. The following quotes elaborate on this part.

> *In itself, the content does nicely fit the questions that I have and the problems that I face when I am developing [digital] learning paths. (Female, age 24)*

> *It is [relevant] because I can apply it immediately in what I am doing now: making my courses digital. (Female, age 52)*

Besides the link to professional and personal needs, there is also a form of relevance identified due to the fact that the programme creates a certain 'viewpoint' towards online teaching. Some participants argue that it provides them with a new lens to look at their own practice and to critically question their current educational practices. Furthermore, the participants advocate that the programme offers them a kind of awareness pertaining to the possibilities inherent to online teaching and that it connects with their current knowledge. Some participants even make the transition towards how their students will use this new technology. However, most of the participants look from their own point of view and how the possibility of online teaching affects their own teaching practices.

> *Looking with a different perspective towards your own teaching practice, can only be beneficial after 30 years of teaching. (Female, age 55)*

> *It is not too difficult but it [the DD programme] still offers enough new insights. The overview of the different digital aids and design principles are very useful for my own practice. It gives me the chance to think about whether or not this [online teaching] would be relevant to my students. (Male, age 48)*

The content part of the survey also asked the participants on how they perceive the implementation possibilities of the content offered within the programme. On this part the participants were less positive. There was a difference between the perceived usefulness of the content and the perception on the implementation of it. Although there was no doubt on the usefulness of the content, the participants indicated that they were doubtful if they could actually implement it in their practice. The participants mainly indicated two reasons for this, namely: not having enough time to implement it thoroughly, and the lack of institutional support or institutional barriers (e.g. infrastructure, institutional culture).

> *I think it certainly can be integrated, if it will be simple, that I do not know. There is a lot to take into account. Specifically, the time investment for the development and the dissemination is very intense. There are some limitations as to the tools and the type of platform. (Female, age 41)*

In alignment with the answers of the participants, the coaches indicate that the content offered in the DD programme proves to be relevant and useful for the participants. The coaches see the greatest merits in the fact that the programme makes use of relevant cases and the immediate transfer to practice for the participants. Constructing a product that the participants can use in their own practice, by working with practical tasks in a case chosen by the participants, is highly favoured by the coaches and adds to them a matter of relevance to the programme. However, the coaches also acknowledge that they do not view the actual implementation of online teaching as an easy part. Therefore the coaches advocate to ask the participants at the beginning of the programme to their perceived implementation possibilities of online teaching, to create a more realistic product as end.

> *A strong point is certainly the content offered. That do all my participants tell me, that the content is good and that they see how it can contribute to their practice. Although, there was one who started and it was not sure if she was able to implement it [online teaching] … she continued but I noticed that is was not with the same motivation anymore. (Coach 2, female)*

> *I think that it [relevance] comes because of the tasks, which I heard from [X], that she could effectively apply it [the content] because of the practical tasks. If you do not give any tasks, then I think that would be more difficult … because of the tasks you get a concrete final result towards which you can work (Coach 4, female)*

#### *3.2.3 Practical level*

At the practical level the participants evaluated if the tasks were available on time and if they had enough time to complete them. Commonly, all the necessary information and tasks were found to be online on time. However, there was a very strong indication that the entire DD programme was very intense for such a short amount of time. Many participants struggled to finish their tasks or modules, which resulted in the fact that many participants were in different modules throughout the programme. This also may have contributed to the drop-out of some of the participants. Of course, this time investment is highly personal, and most of the participants estimated quite well the amount of time that they would need to accomplish a module or task.

> *It takes a lot of time to create something new. I preferred to develop an entire course, but I had to restrict myself to two chapters. It was a very challenging trajectory that I chose, and I did not have much time available. (Male, age 52)*

The answers given by the participants on the practical level are in many ways the same as the coaches' answers. The coaches acknowledged that they too had some trouble in finding enough time to provide decent guidance, specifically at the end of the DD programme. Next to that they also refer to the fact that the programme is very intense and time consuming for the participants. Nevertheless, all the coaches do indicate that they would do the coaching process again. They were generally satisfied with the organisation of the programme, albeit that they also identified some points of improvement.

#### *3.2.4 Recommendations from the participants and coaches*

The recommendations from the participants focused especially on two aspects, namely: content level and practical level. Even though these recommendations are personal, some general suggestions could be identified. First, most of the participants would like a more thorough an in-depth coverage of the pedagogical part of teaching online. Second, many of the participants indicate that the DD programme should be spread over a longer period of time, making it more flexible to their everyday work practice. Last, a small part of the participants also indicated that there was too much textual information on the website of DD, and that it could be a lot more interactive. According to the coaches, the programme should be more flexible towards the deadlines of the tasks and the workload should be less intensive. The participants should also have a clearer view on the expected workload and deliverables. The following quotes of the coaches indicate that their recommendations indeed align with the recommendations proposed by the participants.

> *It is three months between begin and end date, but it is a lot [of work] in those three months … I also slowed down [on my coaching] due to the amount of work waiting for me on my desk. (Coach 2, female)*
>
> *They should clearly know where they are going and what we expect from them. That is what we did … we used a brainstorm to gather all the ideas … we also showed a possible product … to make this more concrete because we noticed that it is not evident to make clear with what we [the coaches] mean. (Coach 5, female)*

## 4. Discussion and conclusion

Due to the increase of online teaching many teachers are now being confronted with a large range of new teaching possibilities. Many teachers are still trying to find their way in this digital environment and thus many institutions are confronted with a need to train their staff to teach online (Wilson 2012). In this respect the Digital Didactics (DD) programme was developed to introduce teachers with the didactical possibilities of online teaching. Based on the results, it is found that the experiences of the participants and the coaches are in a great way similar to each other. The guidance, content and practical arrangements were generally considered very useful and well-planned. However, the intensity of the programme appeared to be a point for improvement. Both the coaches and the participants agreed that the amount of required work from the participants and coaches – within a determined amount of time – led to an overwhelming workload for both. In this respect, future professional developments for online teaching should be more attentive to teachers' everyday practice and professional calendar (Gregory and Salmon 2013).

The participants of the DD programme were generally very positive concerning the perceived merits for their own practice, due to the fact that situating professional development in teachers' practice is a good strategy to make the professional development relevant for the participants (Borko, Jacobs and Koellner 2010). However, the participants' perception on the implementation of online teaching in their own practice indicates that they view this part as a possible barrier. Although this study did not focus on the actual implementation of the programme's content, the implementation of online teaching into one's own teaching practice, remains an important component to consider. The institutional barriers that teachers face when they want to implement certain parts of the professional development (Guskey 2000), prove to be important components that need to be considered by teachers and teacher educators in a professional development for online teaching. Next to institutional barriers, time-related concerns, supportive measures and matters of relevance should also be taken into account (Watson and McIntyre 2012). Furthermore, the participants of the DD programme indicate that the pedagogical aspect of teaching online, should receive a more pivotal role within the training programme. Future research can address more thoroughly this recommendation.

As to the limitations of this study the researchers would like to stress that the results are based on a small group of participants. Due to the small population the results cannot be generalised for all teachers facing a transition from face-to-face teaching to – more – online teaching. Furthermore, it would be interesting to investigate, with a quantitative approach, if the differences between the participants and the coaches show certain patterns or relations. Next to that, the researchers acknowledge that the first research question could be analysed more thoroughly. Due to certain restrictions, the researchers were not able to address the former stated limitations, in this paper. However, the insights of this research do add to the knowledge on contemporary teacher professional development for online teaching. More research is needed on effective professional development models and their translation into teacher professional development strategies. To conclude, there is a follow-up study already planned to investigate – in-depth – the long term effects of this professional development programme.

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# Adaptation of Testing: Yes or no?

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**Abstract:** In the school environment, terms such as personalization, individualism and adaptivity are becoming more and more frequent. The teacher is faced with a difficult task – try to meet every student's needs and requirements, their individuality and the way and pace in which they learn. The teacher does everything in their power to teach every student what they intend to teach them and what they expect them to know. What options does the teacher have? One of the options is to take different learning styles into account and work with the study material which suits the particular student's learning style – as far as the visual student is concerned, the teacher will need graphs, tables, diagrams or schematic notes; the kinaesthetic student, on the other hand, will require video recordings or practical applications. Another option is to adjust to individual students when evaluating their knowledge, i.e. during testing. How can the "adjusting" be realized? Can it be achieved by adjusting to students' level of knowledge or rather by adjusting to their learning styles? And does this kind of adaptive testing have an impact on better understanding and preservation of knowledge? The paper deals with the issue of adaptive testing and tries to answer the above questions. Our research was aimed not only at the real testing (question – answer), but also at the so-called self-testing. By self-testing we mean repetition of knowledge before the real testing, i.e. when the student goes through different variants of test questions and tries to answer them correctly. The student can answer each question multiple times. After each attempt, they can use "Hints", "Study Material" or "Help", all of which should help them answer the question correctly. For both the self-testing and real testing, an algorithm has been created which takes the student's current level of knowledge into account when selecting the next test question. The functionality of the algorithm was tested on a sample of 9th grade students. The results showed that the improvement in terms of knowledge was apparent mainly in the weaker students. Even though they still did not match the better students, they moved up a level or two.

**Keywords:** learning styles, adaptivity, adaptive testing, self-testing, adaptive testing algorithm, motivation.

## 1. Personalization, adaptation

Teachers have always been expected to educate students in different areas and thus help them find their place in society, giving them an opportunity to use the knowledge they acquired in school. And at one time or the other, every teacher must have asked themselves the following question: How can I teach as many students as possible (ideally, to teach every student everything)? To achieve this goal, the teacher may try to use didactic games, an unconventional teaching method, try to move the instruction to a different environment or to teach the curriculum in different ways – the teacher always tries to adjust to the student and their needs; they try to approach each student individually.

Is adapted, or individualized, instruction any different? According to Spencer (2011), there are four levels of personalization (he uses examples from music):

**Standardization – Level 1**

This level includes the entire classroom (group): What does the classroom need? How to motivate the entire group? The teacher has one material for the entire classroom and hopes the majority of students will find it interesting and satisfactory. As far as the teacher's preparation is concerned, it is the easiest way. However, it so happens that some of the students become bored and are left out of the instruction. To use an example from music, it is as if the teacher plays them only one music style (or a radio station) and they either like it or they don't.

**Differentiation – Level 2**

This level takes into account different levels of knowledge that are to be found in the classroom: What do the groups with different levels of knowledge need? How will the study materials for different groups differ? Based on the students' skills and knowledge (or their learning styles), the teacher divides them into groups and works with them in a differentiated manner. This way, however, is more time-consuming and the differentiation of students into groups can even be incorrect and misleading. To use an example from music, it is as if the teacher offers their students 40 radio stations and each group can choose which station it will listen to.

**Adaptation – Level 3**

This level offers an individual choice: What does my student need? How can I best determine the student's needs and adapt the instruction accordingly? Based on the teacher's recommendation, the student should learn exactly what they need. However, the main disadvantage of this approach is that even though the student can choose from various study materials, the choice is still limited (as the teacher provides the selection and they may have forgotten to include other relevant materials). To use an example from music, it is as if the students listen to a radio station that responds to their preferences – I do/do not like the song. The radio station has a database containing the information about the preferred type of music, based on which it offers the students similar songs. In other words, the radio station is able to adapt to the student's current "song" mood.

**Personalization – Level 4**

The students learn on their own: What does each student need and how can they express those needs? How to go from memorization (from general instruction) to the "teacher-one student" dialog? It is based on respecting the individual's autonomy and identity; each student controls their own learning process. However, a problem arises when there is a student who is not used to working alone. To use an example from music, it is like a jam session, i.e. a musical session where musicians play by improvising without extensive preparation or predefined arrangements. Each instrument matters and together they create music.

All the levels can be taken as the gradual development of the teacher, their ability to improve their material-preparation skills, their skills regarding the organization of the education process and their growing effort to teach everyone everything.

And what about adaptivity? Is it the same as personalization? If we look at the following division (Hill, 2013), we will see differences:

**Differentiated learning**

Differentiated learning is a kind of learning with a number of ways in which students approach a new curriculum. Students are divided into categories, with each category being different in the way of learning and approaching new information.

**Personalized learning**

Personalized learning is a kind of learning where each student takes different paths to achieve their educational goals. Before the start of instruction, the student takes a pretest, which determines their individual "path".

**Adaptive learning**

Adaptive learning takes into account the student's results during the entire time of instruction. It is a dynamic process as the student's "path" can be changing all the time.

From this perspective, adaptive learning seems to be the perfect way to help the students learn something. The student goes through the educational environment. They do not have to follow only one path. Based on the current level of knowledge, they can take different paths. The current level of knowledge can be determined by control questions during the course of instruction. If the student answers the question correctly, they can continue in their current path. If the student answers incorrectly, they are offered a different form of instruction, a more detailed example from practice, etc. It is the dynamic adaptation of the learning environment to the student's current level of knowledge.

### 1.1 Adaptive teaching model

A number of parts are needed in order for adaptive learning to be realized. One of those parts is the creation of the **adaptive study material** (Šarmanová et al, 2011). What kind of material should it be? The content will be the same (the teacher must follow the School Educational Program and Framework Education Program). It is the structure that will be different. We need to consider that while someone prefers to start with a practical example, someone else may prefer to start with a theory; and also that while some students prefer little text and as many images as possible, other students may prefer text-based materials. And the number of such factors may increase over time.

The teacher needs to do a number of things – find out each student's preferences, prepare suitable materials, give the materials to the students according to their needs, etc.

That is why another part – the LMS, preferably an **adaptive LMS** – is needed. The adaptive LMS should be able to react to the student's changing needs. First, it sets their way through the education process, taking their learning styles into account, and offers them suitable study materials in an appropriate order. If the student answers control questions incorrectly, but at least part of their answer is correct, the system offers them an instructional layer or gives them more examples.

After each thematic unit, there is **self-testing** (practice test), which should be adapted. The student answers test questions and the system reacts to their answers. If the answer is correct, it generates a more difficult question. If the answer is incorrect, it generates a less difficult question. And what about the formulation of a test question? An adaptive formulation will take into account whether the student prefers graphic-based or text-based materials. And since it is not the real testing and we want the student to learn and remember as much as possible, they can use the so-called "Study support" or "Help" (see Chapter 4). The student eventually reaches the correct answer (Prextová, 2014).

It is the possibilities of adaptive self-testing, the proposition of its algorithm and its use in practice that this paper is aimed at.

## 2. How does the student learn?

One of the possible ways to adapt a study material is to focus on the student's learning style. And why the student's learning style? Each person is unique, which means that what suits one, might not suit another. Individualism can be seen in all areas of life – behavior, the way of acquiring information, the way of learning, **the learning style**.

It is difficult to define a learning style. As a result, there are several definitions. According to the Pedagogical dictionary (Průcha et al, 2009), a learning style is *"learning methods through which an individual approaches a majority of pedagogically related problems during a certain period in life. To a certain degree, they are independent of the content of learning. They are inborn (cognitive style) and are developed through internal and external influences"*.

The following definition is quite similar (Riefová, 2007): *"a learning style is the way in which an individual deals with terms, everyday situations, learning preferences, …, how they approach thinking and how they best perceive and process information".*

Švec (1998) defines a learning style as *"an individual feature (oddity) in which subjects differ. They can be perceived as an inner set of skills which the subject acquires"*.

In his book *Learning Styles of Pupils and Students*, Mareš (1998) deals with learning styles in detail. He argues that the learning style *"is a meta strategy that contains distinctive learning strategies, learning methods and operations. The meta strategy monitors them; evaluates them; points them to certain directions; regulates them with regard to learning conditions, achieved results and social context of learning. Learning styles help the student achieve results of a certain type, but make it more difficult to achieve results of different types (often better)"*.

There are a number of learning styles (see the following paragraph). It rarely happens that one person has only one learning style. Mostly they have one dominant learning style which they use most often. However, when they encounter a different kind of situation, they use a different learning style. The question is whether we do not suppress the less dominant learning styles by preferring the dominant one. Would not it be better if we tried to help the student develop their weaker sides and thus enrich their “learning style portfolio”? However, until we come to a conclusion, it will be better to follow the existing pattern – to use the student’s dominant learning style to improve their motivation, activation (not only in classes), to keep their attention, and for long-term memorization of knowledge.

There are a number of classifications of learning styles from different points of view. In our research, however, we draw on Dunn and Dunn’s model of learning styles (1993), Riding’s model (1997) and Sovák’s typology (1990).

Dunn and Dunn argue that the learning style is influenced by the following factors:

- Learning environment – in what environment the student works, the light intensity, the number of noises, temperature differences, etc.;
- Emotional impulses – different motivation, responsibility, endurance and planning;
- Social impulses – the student prefers to work alone, prefers to work in pair or in group;
- Physiological impulses – the student’s **sensory preferences**, in what part of the day their learning is the most effective, etc.;
- Psychological impulses – how the student processes information (analytical, global, reflexive, impulsive).

Riding, on the other hand, mentions cognitive styles which represent the individual’s approach to the organization of learning and information processing. He introduces the following types:

- Analytical – the student analyzes information one at a time;
- Global – the student focuses on the entire problem, not on details;
- Verbal – the student requires information in the form of text, words, phrases;
- Visual – the student requires and processes information in the form of image.

As far as sensory preference is concerned, Sovák introduces the following types:

- Auditive – hearing is the prevailing sense. Students of this type prefer lectures. When learning, they tend to read the curriculum out loud or discuss it with others.
- Kinaesthetic – touch and movement are the prevailing senses. Students of this type prefer breaks in learning, tend to be restless and like practical examples.
- Visual – sight is the prevailing sense. Students of this type prefer a text to a lecture. They can easily remember on which page a particular curriculum can be found or in which color it is written. They prefer a graphical presentation of the curriculum.
- Verbal – word is the prevailing sense. Students of this type can easily remember even more complicated definitions, formulas and texts because they can logically process and work with individual terms. They prefer textbooks and even search for additional materials; they do not have a problem with a coherent text.

Since the creation of an adaptive material for all existing learning styles is beyond our powers, and since it would require cooperation of a number of pedagogical and psychological experts, we decided to narrow the selection down to two learning styles – verbal and visual. The questionnaire for determining learning styles (filled out by the research sample before the start of the research) showed that verbal and visual were the prevailing learning styles. However, we do not rule out the creation of further study materials for other learning styles in the future.

## 3. How the student finds out what they already know?

The next step after the actual “learning” is the acquisition of feedback which is beneficial both for the teacher and the student. Again, there are several ways to acquire feedback. However, the paper focuses on the acquisition of feedback through testing, namely **self-testing** – a preparation for the real final testing. Basically, self-testing is a kind of testing where the student has more than one attempt to reach the correct answer. The goal of self-testing is to provide feedback immediately after each question – about the correctness or incorrectness of the answer; or to offer the student the so-called “Hints”, which is continuously modified after each incorrect answer to help the student reach the correct answer or to show them the process leading to the correct answer. The continuous modification of "Hints" on the basis of the student's answers is the first element of adaptivity.

Another element of adaptivity is the student answering test questions and the system reacting to their answers. If the answer is correct, it generates a more difficult question. If the answer is incorrect, it generates a less difficult question (see Chapter 4). This, again, leads us to the need for the adaptive LMS.

## 4. Adaptive self-testing

As has already been stated in Chapter 1.1 - Adaptive Teaching Model, neither adaptive instruction nor adaptive self-testing are possible without the adaptive LMS. The **Barborka** LMS, which is being developed by a group of researchers at the Department of Information and Communication Technologies of the Pedagogical Faculty of the University of Ostrava, was used for the purposes of the research. This system can adapt instruction on the basis of the student's learning characteristics – with regard to the preferred type of study material (images, videos, text) or the preferred type of studying (in-depth or surface). The system contains an adaptive study material, which every teacher can create and save it in the system. To facilitate the work, the abovementioned group created a template for the creation of the adaptive study material. The adaptive study material is based on the teacher dividing the content of the curriculum into smaller parts (layers), e.g. the theory, the semantic part, the examples, the motivation, etc. The teacher then creates different versions of those layers corresponding to the students' sensory preferences (verbal, visual, auditive, kinaesthetic) and to the different types of students based on their level of understanding (basic content, enhanced content, detailed content). This reveals another possibility for adaptation – changing the sequence of layers can make the way through instruction easier for a particular type of student. The experimenter would probably prefer to begin with examples rather than the theoretical layer. On the other hand, the theoretician would probably prefer to begin with the theoretical layer and leave the examples for last. For further information about the Barborka LMS and the creation of adaptive study materials, we include a link to the following article: Methodology for Creating Adaptive Study Material (Kostolányová, Šarmanová, 2013). However, the Barborka LMS does not include adaptive self-testing or real adaptive testing.

### 4.1 Creation and classification of test questions

Before we can propose an algorithm, we need to deal with the following alternatives. If we are to adapt questions on the basis of the student's answers (if they answer correctly, the next question is more difficult; if they answer incorrectly, the next question is less difficult), we need to create **question categories according to the level difficulty**. In the research, we used 5 levels (1 being the most difficult category). We also based the division of questions into the individual levels of difficulty on Tollingerová's classification of educational tasks (Tollingerová, 1970) and on a detailed analysis of the questions.

If we are to adapt questions on the basis of the preferred learning style, we need to create **question categories according to the sense**. In the research, we focused only on two types of students – verbal and visual. We based the division of questions into the individual sensory categories on Kostolányová's description (Kostolányová, 2012).

As the research was aimed at the 9$^{th}$ grade students and mathematics, we based the **set of test questions** on Odvárko and Kadleček's mathematics textbook (Odvárko, Kadleček, 2000).

As self-testing should prepare the student for the real testing and help them remember and learn as much as possible, we want to encourage them even when they answer incorrectly on more than one occasion and give them a chance to reach the correct answer (providing them with various types of help). That is why each question contains "Tutorial" (a link to a PDF material on a particular topic) and "Help" (the entire problem-solving process with the correct result).

### 4.2 Self-testing - proposition and creation of individual steps

The following is what the practice test process should look like: The student logs into the system (under their ID). We assume that there are metadata about the student in the system – their sensory type (visual, verbal) and their success rate. If the student has taken the practice test before, their success rate from the previous test is stored in the system. If it is their first time, their success rate is set to 50 (max 100).

Based on their sensory preference and success rate, the student is presented with a question of a particular level of difficulty. The student answers it and the system evaluates their answer. The flowing situations may occur:

- The answer is correct: the student's success rate improves;
- The answer is incorrect the first time: the system generates a report about an erroneous answer, the student's success rate decreases, the student tries to answer the question again;
- The answer is incorrect the second time: the system can (does not have to, it is the teacher's decision) display "Reaction", which is the so-called expected incorrect answers (based on experience), the student's success rate decreases, the student tries to answer the question again;
- The answer is incorrect the third time: the system generates "Tutorial" (a link to a PDF material on a particular topic), the student's success rate decreases, the student tries to answer the question again;
- The answer is incorrect the fourth time: the system generates "Help" (the entire problem-solving process with the correct result), the student's success rate decreases, the student tries to answer the question again.

Based on the calculated success rate, the student is presented with either more difficult or less difficult questions.

In order for adaptive testing to work correctly, the rules needed to be established – how the success rate is calculated, how the individual Helps are displayed. The following rules were established:

- The relation between the student's success rate and the level of difficulty;
- The change of the success rate for correct/incorrect answers;
- The change of the success rate for repeated incorrect answers (incorrect answers 2-4)
- The system's reaction to the correct answer;
- The system's reaction to repeated incorrect answers (incorrect answers 1-4).

For a more detailed description of the adaptive testing algorithm and rules, see (Prextová, 2014).

## 4.3 Implementation

The adaptive LMS with adaptive self-testing was tested on a sample of 53 9$^{th}$ grade students (14-15 years old). For many of them it is a stressful time as they are deciding their future, choosing the right high school.

Each student was assigned an ID number, which they used during the course of the test. The first step was taking an entry test consisting of 9 questions each of which represented a different level of difficulty (Figure 1). All of the questions focused on topics the students knew very well as they had been preparing for their high school admission interviews. They were the following six topics: Number and variable; Expressions and equations; Data, graphs, tables; Functions; Plane geometry; Space geometry.

Using a simple fraction, write what part of each picture is colored.

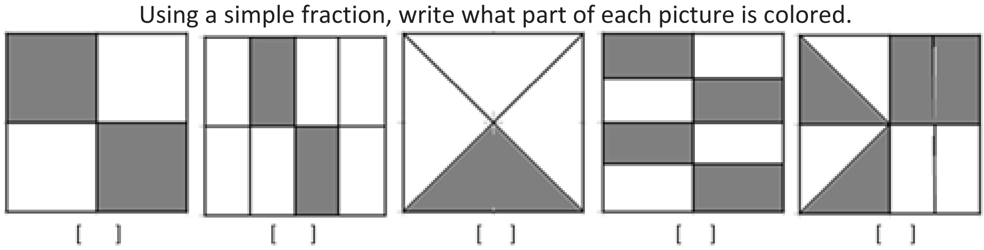


**Figure 1:** Test question from thematic area Plane geometry

As far as the second step was concerned, the students were provided with information about the Barborka LMS (how to login, etc.). When logged in, under Mathematics the students found an adaptive practice test consisting of questions of different difficulty levels. Each question contained information about the type of student it was intended for (visual, verbal). Each question also contained the following:

- "Tutorial" – a link to a PDF material on a particular topic;

- "Help" – the entire problem-solving process with the correct result.

During the week, the students were allowed to use the system, practice and deepen their knowledge. The LMS records the student's every "move" – selected questions, answers to the questions and the time spent on individual questions.

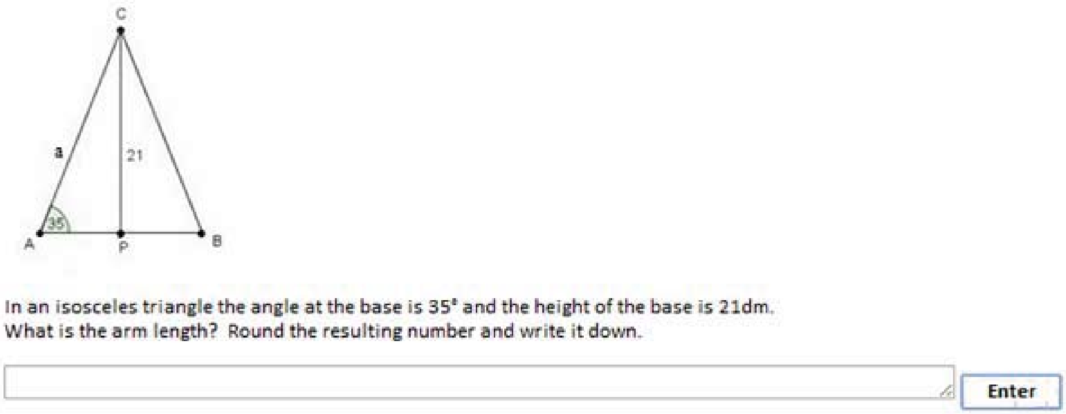


**Figure 2:** Test question from thematic area Functions

The last step was taking the final test which contained questions similar to those in the entry test.

## 5. Adaptive testing – yes or no?

When we compared the results of the pretest and the posttest, we learned the following: *The students achieved better results in the posttest*. The question is, however, how much this result was influenced by the implementation of adaptive testing. Because it can be said that the posttest results will always be better than the pretest results.

However, we further learned that: *The posttest results of students with an average grade of 3-4 (in Mathematics) were much better than their pretest results*. On the other hand, the improvement of the students who were already good at mathematics (average grade of 1-2) was insignificant. Could adaptive testing play its part in it?

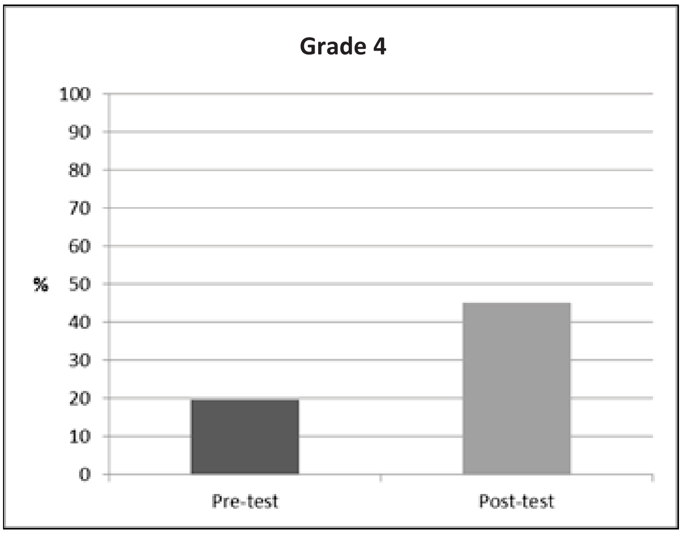


**Figure 3:** Students with average grade 4 in mathematics

We were there for the entire testing process, observing students during the individual research phases, interviewing both the students and the teachers. And it were the students weaker in Mathematics (who found certain parts problematic), or the students who were previously not interested in the subject, who found adaptive testing helpful:

- First of all, they appreciated that they could submit their answer more than once. They stated that the uncertainty resulting from their limited knowledge of Mathematics often leads to their being absent-minded, nervous, incorrect understanding of the task, choosing the incorrect answer by mistake, etc.

- They also appreciated the PDF materials which helped them find the information needed to solve the task. The teachers also appreciated the PDF materials as they cannot be in two places at once.
- The students also liked that when they had difficulty solving the task, they could see the entire solving process and the correct result (as – again – the teacher cannot be in two places at once).
- The teachers also appreciated the students' motivation to improve. The students were told that the testing was adaptive and that the tasks were being presented to them on the basis of their answers. Ambition and determination to surpass the better classmates were important factors. The students knew that the easy tasks were always going to be followed by the more difficult ones. The determination to match the best classmates was clear. It was interesting to see that, as the time passed, everyone started to work alone, did not let anyone bother them, was making notes and was trying to find another solution than the presented one.
- The elements of gamification can be seen – the students do not get badges or points, but collect more and more difficult tasks and examples.

The abovementioned points lead us to the fact that the implementation of adaptive testing into (but not only) instruction could be purposeful as it motivates the students to improve and try and match the best classmates. Even the teacher knows that this form of testing can be used not only in instruction, but also in home revision or preparation for a test or an exam.

The following are other possibilities that adaptive testing offers and that can be considered:

- Test tasks and materials could be adapted to the remaining learning styles – auditive and kinaesthetic (What would such a material look like?);
- Not only the formulation of the tasks, but also the type of questions could be adapted (Are the offered answers better suited for the kinaesthetic or the visual type?);
- Consider the possibility that even the verbal type can, in some situations, prefer the visual study material (Would not it be better if all the students could choose from all the materials, instead of just their preferred ones?);

As far as a student with a particular learning style is concerned, consider whether it would not be better to help them develop the remaining, less developed and less used styles…

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# Securing Trust, Roles and Communication in e-Advising

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**Abstract:** Students claim to learn a lot from advising and feedback on assignments. This is one of the results in a survey amongst students at Hedmark University of Applied Sciences. Advising is mainly a face-to-face activity. However, with an increasing number of courses being offered online, it is timely to discuss how to conduct advising sessions online and using an online medium. The meeting between the student and advisor contains a number of factors; for instance: eye contact, tone of voice, facial mimic. Many subtle features establish the relationship between the advisor and student. The student needs to communicate the assignment and to trust the advisor, the advisor needs to be reassured that the student understand and trust the feedback. The paper discusses how advising sessions can be undertaken using an online medium, and still maintain the roles, the trust and secure the communication.

**Keywords**: e-advising, reflection, reflective practitioners, trust, competency

## 1. Introduction

Online education is offered by many institutions in higher education in Norway, also at Hedmark University of Applied Sciences. At our university we offer a variety of online studies. Some studies are only delivered as e-learning and some are net- and seminar based.

These courses differ from on campus education by the lack of physical meetings. With the way the online courses are organized, it is possible to stay at home, at work or whichever place, to learn. There is an ever growing marked for e-learning and online education and the number of courses and studies offered as online or net- and seminar based are increasing in number to supply a growing market.

With the increasing demand from the market, we have seen the emergence of MOOC's (Massive Open Online Courses). However, the dropout rate is quite substantial – sometimes up to 70% (Hone and El Said, 2016). There has been several studies on MOOC retention and according to Hone and El Said refer to research showing that students that had prior experience with MOOCs had a higher retention rate (2016). Also age and level of education had an impact; the older and more educated, the higher retention rate was shown. This suggests that motivation for joining the course may have something to do with it.

Eom and Ashill claim that course design, instructor, and dialogue are the strongest predictors of user satisfaction and learning outcomes(2016). This means that the design of the course should be focusing on adapting the course material, structure and content to suit an online situation. The options for contact and dialogue with the students also need careful attention, and the instructor should be trained in delivering education in the online media. In this paper we will focus particularly on the instructor and dialogue between instructor and student.

## 2. Theoretical background on advising

Going from on campus to online learning the change of media has posed some different issues regarding advising. Bolter call this a "remediation" which he defines :

> *We might call each such shift a "remediation," in the sense that a newer medium takes the place of an older, borrowing and reorganizing the characteristics of writing in the older medium and reforming its cultural space(Bolter, 2001).*

Tveiten has defined academic advising as "..a formal, relational and pedagogical process that enables (and empowers), and that aims to strengthen the personal mastery competence through a dialogue based on knowledge an humanistic values" (translated from Tveiten (2006)) in Kaare Skagen (2011).

The students report in several research reports that, reflecting back on their study period, they recognize that advising on student assignments and thesis was what they learned most from. Even if they claim to have learned also from other elements of their education, the advising was ranked very high (Kjeldsen, 2006, Ranglund, 2012b).

The advising session is generally built up by different phases. First it is the beginner phase (introduction), the personal phase, and the equality phase (Pettersen and Løkke, 2004). Here the role of the advisor in more of an instructor, meaning that the advisor in this phase is the one that has the knowledge that is to be shared. However, it is important to empower the student to make their own choices. As Ausubel says, quoted in Pettersen and Løkke (2004): "…the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly".

The second phase is where one develops a learning alliance between "the partners" (the learner and the advisor) which symbolizes the symmetrical relationship that has now developed (Pettersen and Løkke, 2004). The advisor explores what the student presents, and challenges the opinions and perceptions of the student.

The third phase is the consultative phase. Here the student has acquired knowledge and feels empowered with regards to defending his or her own work as a student.

We also want our students to become what Schön refers to as "reflective practitioners"(Schön, 1987, Schön, 1991). It is thus important to facilitate for these reflections. This can be done by making the students write reflective journals (Bassot, 2013, Moon, 2004, Moon, 2006). They can also be offered feedback on these journals. However, giving feedback on these journals can be a challenge if one has not experienced writing such reflective journals themselves. The journals may not only be in writing and by email or posted in a forum in a Learning Management System. They may be recordings that the students present as streaming video for all (including fellow students) or just to the lecturer.

In an online medium, the body language will be a lot more absent than in face-to-face advising. It is thus important to take the other issues into consideration, such as organization and the interrelationship between advisor and student. It may also be important to be specific and clear about what the student can expect from the advising sessions and stick to that. This may also be a part of the establishing of trust. Also the students working online seem to be very focused on the curriculum. They are in our experience not interested in discussing issues that is not within the scope of the assignment. This is supported by Peltier, Drago et al. (2003).

The students need to be confident about the competency of the advisor. This may be the most important factor, particularly for the older, more experienced students. They are in our experience more specific about their needs, even if they as a group also need to get the establishing of routines regarding how and when the advising is to be undertaken. The competency of the advisor can be viewed as in Skau's "Triangle of competency" (Skau, 2002). The advisors theoretical knowledge, the personal competency and the work specific skills are important when securing the trust of the students. The advisor should have skills on the area on which the student is to be advised. The personal competency of the advisor is about handling the communication also in an online medium. To be able to communicate also in this medium in a way that will establish the cooperation that this "relationship" needs is important. The work specific skills also say something about the advisors skills regarding communication in different media. They not only need to master the face-to-face on campus advising, but also be able to be to the point and show theoretical skills in an online medium. The different media will also require different communication skills.

One work specific skill is also to *listen.* In order to understand the needs of the student and to make the student also feel *seen* or *heard* can be viewed as a skill(Ranglund, 2012a). To listen and understand the require aids the process of providing what the student needs. Often when one is advising on a topic of special interest, it can be difficult not to impose one's own values and knowledge on the student. This may obstruct the learning process as the student may feel that it is no longer one's own work(Ranglund, 2012a). It may also lead to confusion and this is obstructive towards a learning process (Kember, Jones et al., 1999).

The different media need different approaches regarding communication. If it is about using a video based medium, such as Skype, it is possible to add mimic and body language to a certain extent. In emails and other asynchronous media, this is not possible. It is thus important to be able to express oneself in such a way that they are able to understand and be encouraged to follow the advice. This is confirmed in a study at Universitas Terbuka (Suciati, 2011).

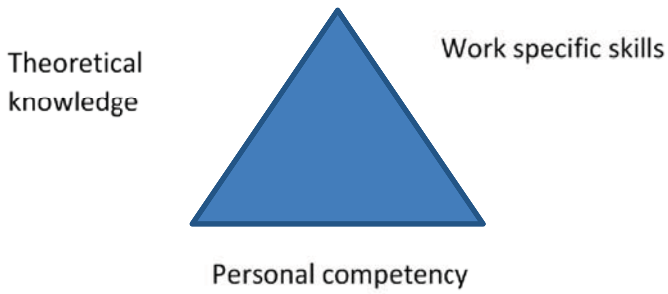


**Figure 1**: The triangle of competency, translated from Skau (2002)

To explain this further, it is e.g. important to be supportive and keep a balance between positive and negative feedback. The feedback also needs to be very specific and constructive. Even if the students may use an impropriate language, it is important that the advisor stick to a more formal language. There is however, a difference between sticking to a formal language on the one hand and bridging the gap between the advisor and student. Løkensgaard Hoel (2001) saw the importance of adding typing mistakes in order to lower the level of communicating with the students. Her experiences were that if she were correct and very formal, she would get little questions or other feedback. If she "picked up" on the students mistakes, it made the threshold lower for the students and they were more interested in sending her emails.

Predictability is also important. Light (2003) states the importance of having meetings on a regular basis as this:"… provide the positive growth experiences for students that enable them to identify their goals and talents and learn how to put them to use. The caring attitude of college personnel is viewed as the most potent retention force on a campus." Herbert claim this also apply to e-learning (2006). Regulated and predictable contact with faculty staff and also their attentiveness to students needs are rated high with regards to contribute to student retention and student satisfaction.

Clarity and eliminating misunderstandings are also important. In a simple version of a communication model, noise and "interference" is what may be obstructing the mutual understanding of a message.

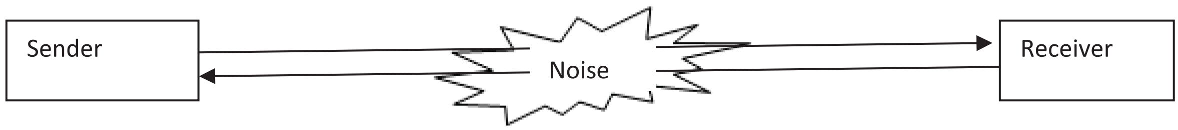


**Figure 2**: The simple communication model

Noise can be for example different cultures, different age groups and gender, and the channel in which the communication takes place (Dahl, Habert et al., 2001). It is important to reduce noise as much as possible, but it is equally important to establish what the noise consists of.

The students need to be confident about the competency of the advisor. This may be the most important factor, particularly for the older, more experienced students. They are in our experience more specific about their needs, even if they as a group also need to get the establishing of routines regarding how an when the advising is to be undertaken. The competency of the advisor can be viewed as in Skau's "Triangle of competency" (Skau, 2002), a triangle of factors interdependent on each other. The advisors theoretical knowledge, the personal competency and the work specific skills are important when securing the trust of the students. The advisor should have skills on the area on which the student is to be advised. The personal competency of the advisor is about handling the communication also in an online medium. To be able to communicate also in this medium in a way that will establish the cooperation that this "relationship" need is important. The work specific skills also say something about the advisors skills regarding communication in different media. They not only need to master the face-to-face on campus advising, but also be able to be to the point and show theoretical skills in an online medium. The different media will also require different communication skills.

## 3. Discussion

The difference in media will affect the communication. Sometimes the media is chosen for the course and one just have to adjust accordingly. It is thus important that the faculty staff have skills and competency in advising in the different media that it is possible to advice in. The media may be synchronous and allow for video stream, but it may also be asynchronous and require different approaches than using mimic and facial expressions as one can in a video stream.

Viewing the student's background and do a proper search on one's audience is also recommended. This target group investigation may be well worth. Morris and Finnegan (2009) claim that first year students and first timers are the most likely to drop out. They will thus need extra attention as opposed to the more experienced students that have undertaken online courses earlier without dropping out. This is also confirmed in other studies presented by Hone and El Said (2016).

Clarity regarding media in use, what can be expected, at what time they can expect it is vital. To be perfectly open and predictable regarding when to expect feedback, what type of feedback, in what media, etc. will contribute towards the trustworthiness in the relationship between the advisor and the students. This applies to ordinary on campus education, too, but is even more important when the students have no way of showing up "at your office door"(Ranglund, 2012b). This requires planning and a bit of organizing in beforehand prior to the start of the course or study (Eom and Ashill, 2016, Gomez-Zermeno and Aleman De La Garza, 2016, Hone and El Said, 2016, Suciati, 2011)

Teaching and supporting the advisors is important. The advisors need to experience how it "works" in order to fully understand and comply to the situation before him or her. It is a very different situation than the "ordinary" face to face sessions on (or off -if agreed) campus advising session. The more research is done on this and the more experience each advisor gets it is important to share this knowledge and distribute amongst peers. Also to facilitate for reflection not only with the students but also with one self, is important. Sharing experience and co-reflect with peers is necessary in order to learn more(Wenger, 1998)

Regarding making the students write reflective journals, the advisors should themselves be invited to write (or record) reflective journals themselves in order to learn how this is perceived by the students. This may be a very personal undertaking and also puts the "trust" issue at stake. To have ones reflective journal evaluated by a peer requires trust between the parties, not only between advisor and student, but also and maybe more importantly amongst peers (Moon, 2006)

## 4. Conclusion

Summing up, it is necessary to have skills on how to express oneself in a digital media. The medium of communication also have constraints. If one uses a video based synchronous medium, it is possible to use the body language and make use of expressions in order to see if the students receive the advising as intended. In an asynchronous medium like email or discussion forum, it is important to establish rules for the communication. The rules are to secure predictability for the student and advisor. To be clear on the expectations are important in order to establish trust between the advisor and student.

The most important is however the competency on the topic in question. The students need to obtain an understanding about the level of knowledge with the advisor in order to trust the advices given. The competencies the advisor in an e-learning education need are thus wider than in an "ordinary" on campus situation, although this can be difficult enough.

The skills of communicating in an online medium needs to be practiced. Our recommendations are to let faculty staff practice on this prior to advising students online.

### 4.1 Future research

We are planning a project that will develop training possibilities for faculty staff that is about to undertake online advising. The project will also include establishing similar to a Community of Practice (Lave and Wenger, 1991) in order for the new and experienced advisors to meet and share experiences. The experienced advisors (experienced in the online medium) will act as advisors for the "apprentices" – the faculty staff that is learning about how to do advising in a new medium.

The focus will be on testing out all the different types of media, both synchronous and asynchronous, and on communication skills as well as skill on how to make good plans for follow up on online students in order to make them feel taken care of and noticed.

Major emphasis will also be put on the reflecting with peers, not only sharing knowledge and experiences, but reflecting in different ways. It will be facilitated for the learners (faculty staff) to use methods as reflective practitioners (Schön, 1987, Schön, 1991) and provide feedback on their reflective notes from both in and on action.

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# Academic Integrity, Plagiarism, and Mercenary Authorship in Online Learning Environments

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**Abstract:** Academic credentials and their economic value in the marketplace depend in large measure on an academic institution's ability to monitor and certify that a student has obtained a degree without cheating. That validation has become increasingly challenging and expensive in online courses where faculty never meets the students face to face. Not only can students exchange online identities with other students to mask their activities, but there also exists vast networks of people who write original and unplagiarized papers – for a price. What can be done to ascertain that higher education's credentialing ability remains untarnished by these forms of cheating? This paper will offer three alternatives. The first alternative is deterrence. As a defensive strategy, deterrence by electronic means is very costly and resource intensive because it is aimed at a moving target. We will look at the big players in this space, including Turnitin, and look at the legal and ethical questions that arise when the presumption of guilt creates an atmosphere of academic doubt in the online classroom. The second alternative is dissuasion. Here the university enacts and publicizes academic integrity and plagiarism policies that find their way into the syllabus of each course. The problem here is policing and enforcement. This goes to the heart of the academic mission: is it the university's role to police for cheating? And what happens in the case of original but mercenary papers? What must the burden of proof be for the university to make a prima facie case against a student who purchased an original paper to submit for a grade? The third alternative is diagnostic. Here the university proactively looks at the type of assignments that generate the greatest breaches of academic integrity, and works with the faculty to develop online assignments that reduce the incidence of cheating. This has the effect of creating a moving target for students inclined to cheat and puts the focus back of the teaching and learning process. This is the most effective method, but requires an instructional commitment to being a learning organization.

**Keywords:** academic integrity, plagiarism, Turnitin

Cheating has become ubiquitous in the 21st century. From doping scandals in sports that affect results in the Olympic, FIFA games, tennis matches, and the Tour de France, to financial Ponzi schemes that result in instability in the banking and financial markets, to religious institutions where the faithful are bilked out of hard-earned money, to personal relationships where the toll of infidelity can affect generations – cheating causes institutional as well as personal harm. The university is not immune from cheating, but one can argue that the effects of academic cheating reach deep into the very fabric of society because academic institutions are charged with credentialing and employers rely on these credentials when hiring workers. Even social capital is built upon academic credentials. Therefore, it is critical that academic institutions understand how technology facilitates cheating and how best to devise an institutional response to this threat.

Academic integrity has its origins in academic honor codes. Honor codes are predicated upon the belief that a reasonable person can be trusted to act honorably and to follow a common accepted set of ethical principles. In academic institutions where there are strict honor codes in place, such as in military service academies, it is the students themselves who monitor themselves and each other because students have the most to lose because cheating adversely impacts the grades of each person in the class. However, we now live in a world where personal ethics can often take a back seat to personal gain, and where agreement on a common set of ethical principles is often hard to find. Studies suggest that students, especially first-generation college students, can often be confused about what constitutes an infraction of academic integrity (Allmon, Page & Roberts, 2000). Few academic institutions offer guidance in this regard. In an Open Letter to faculty and staff in March of 2015 in response to a cheating scandal involving as many as 20% of students in a large introductory class, Stanford University Provost John Etchemendy reminded the faculty of its responsibility to educate students about "the seriousness of academic dishonesty."

When collaboration in a class is encouraged, as I do in my classes, do we make certain that the parameters for collaboration are clear to the students? Do we provide guidance for the use of technology? And are students aware that we really will seek to identify and report concerns that may arise? (Etchemendy 2015)

Of course, this assumes that faculty and staff are themselves technologically adept to provide such guidance and able to construct collaborative assignments that foster academic honesty. Even at those institutions with timehonored honor codes, there is a realization that honor codes are insufficient to monitor academic integrity (Cheung 2014).

Educational technology has also lowered the barriers to cheating. In 2006, Etter, Cramer, and Finn published an important baseline study regarding the prevalence of cheating using information technology (Etter, Cramer & Finn, 2006). The authors constructed a survey consisting of 24 academically dishonest behaviors and administered the survey at two different types of academic institutions: a church-affiliated small liberal arts college and a community college affiliated with a major research university. The results were strikingly similar despite the seemingly dissimilar student populations.

The four highest scoring items were activities that involved submitting as one's own an assignment completed by someone else. Their mean ratings placed them in the highest possible range, from (4) quite serious to (5) very serious, as forms of academic dishonesty. The next seven items, which fell between (3) moderately serious and (4) quite serious were more difficult to categorize. Three of the behaviors involved possibly unauthorized assistance on an exam. Two others involved questionable delay tactics, falsely claiming to have attached an assignment to an e-mail to gain extra time to complete the work and a non-technical analogue, giving a false excuse to delay an exam or the deadline for a paper.

(…) For six items, the mean ratings for the behaviors are significantly different, but the rankings are nearly identical. This is true for buying a paper, copying and pasting an essay from the Internet, copying a friend's assignment and submitting it as one's own, receiving and using an e-mail from a friend about questions on an exam just completed, using Internet chat rooms to ask homework related questions, and having a friend e-mail a copy of a completed assignment to use as a framework for one's own work. (…) While information technology appears to have only facilitated an exchange or transfer of information for the first six items, for the remaining three the behaviors would be impossible to perform without the diffusion of software innovations (Etter et al, 142-143).

In the years since this paper appeared, there has been an explosion of social media, sharing sites, and cloud-based storage. Technology has made sharing not only easier, but the norm. Students who have been raised in this sharing economy suddenly find themselves at odds in an academic setting where sharing is prohibited. Unlike the prevalent sharing economy, academic credentials and their economic value in the marketplace depend in large measure on an academic institution's ability to monitor and certify that a student has obtained a degree without sharing or appropriation. That validation has become increasingly challenging and expensive in online courses where faculty may never meet the students face to face. Not only can students exchange online identities with other students to mask their activities, but there also exists vast networks of people who write original and non-plagiarized papers – for a price (Hanse, 2004). What can be done to ascertain that higher education's credentialing ability remains untarnished by these forms of cheating? I will examine here three institutional responses: deterrence, dissuasion, and diagnostic.

The first response is a defensive one: deterrence. As a defensive strategy, deterrence by electronic means is very costly and resource intensive because it is aimed at a moving target. Turnitin is the biggest player in this space. Not only is it costly to purchase the software, there are additional administrative and training costs for a successful implementation. Faculty must be trained to read the reports so that they can discriminate between false positives and actual plagiarism.

But perhaps the biggest sea change that Turnitin brings to a campus is a radical shift from a student honor code where students monitor each other for the common good, to institutional monitoring of all students, especially online students. Turnitin may even promote the intrusion of academic integrity doubt on the part of the instructor for the students in the online classroom, whether warranted or not.

And there is more. With the student honor code, the presumption of innocence is with each student. With Turnitin, it is the faculty member who reports an integrity infraction to an academic committee for review. The burden of proof then shifts to the student who must prove his/her innocence. Turnitin cannot distinguish between ineptitude with academic writing and intentional plagiarism. Moreover, penalties for cheating often differ from one institution to another. The academy has not put into place uniform codes or even model codes with associated gradations of penalties for institutions to follow. As a result, first-time offenders may be treated just as harshly as repeat offenders.

The university has a part to play in the proper administration of Turnitin justice. First, the university should put into place an orientation course on academic integrity that every student must take upon admission, and informing the student of the existence of Turnitin and its use in the classroom. Second, the university has an obligation to train its faculty on the proper use of Turnitin. This will go far in eliminating reports with false positives as infractions. Thirdly, the university should create working groups of faculty and students to examine the policies and procedures of the university with respect to academic integrity, making that document a living document responsive to technological as well as legal advances.

This discussion brings us to second response to academic cheating: dissuasion. In this approach, the university takes a proactive position and enacts and publicizes academic integrity and plagiarism policies that then find their way into the syllabus of each course, along with examples, and instructions for how to use Turnitin to check one's own work prior to submission. The biggest challenge for the university using plagiarism detection tools like Turnitin is policing and enforcement and to the faculty's role in detection and deterrence and the resultant workload issue. In a study conducted by Atkinson and Yeoh and published in the *Australasian Journal of Educational Technology*, faculty expressed concerns about "the time taken for the detection process, the restriction to publicly based Internet sources and direct copying, and the extra workload involved with pursuing academic misconduct." (Atkinson and Yeoh, 2008). Faculty have expressed concerns that plagiarism detection software like Turnitin turns faculty into "police officers" and creates a "climate of suspicion in the classroom." (Parry, 2011). However, using the dissuasion approach turns plagiarism detection into a teachable moment. In a survey of faculty using Turnitin, Holi Ibrahim Holi Ali found that "(80%) believed that Turnitin should be used as instructional tool and should be integrated into instruction rather than to be used as a crime detection method." (Ali, 2013).

And what happens in the case of original but mercenary papers purchased online or from paper mills? Purchasing an original paper online is not only easy, it has become a profitable business (Hansen, 2004). Because they are original papers, they can bypass plagiarism software like Turnitin. However, once submitted by the purchasing student as their own work, these papers do become part of Turnitin's database, which will detect future submissions of the same paper, or plagiarized portions of the mercenary paper. Nonetheless, the student who purchased the original paper online got away with academic dishonesty.

The best way for a university to prevent the use and misuse of mercenary papers is for the university to encourage low stakes and ungraded writing assignments in every course so that each instructor has at least once original writing sample from each student. This forms the baseline for the student's writing assignments against which can be evaluated later submissions. This method can also help to deter the use of mercenary papers if students perceive that their own writing will be used as a determiner for a final grade, not just the final paper.

But there is more that can be done systemically to foster academic integrity. The third alternative to counteract plagiarism is diagnostic. Here the university proactively looks at the type of assignments that generate the greatest breaches of academic integrity, and works with the faculty to develop in-class and online assignments that reduce the incidence of cheating. This has the effect of creating a moving target for students inclined to cheat and puts the focus back of the teaching and learning process. This is the most effective method, but requires an instructional commitment to being a learning organization.

How can an academic institution put a diagnostic plan into practice? A first step is to create a faculty advisory committee on academic integrity so as to involve the faculty in the decision-making process. The purpose of this advisory committee will be two-fold. First, the committee will establish guidelines for evaluating the types of assignments that are likely to generate breaches of academic integrity. These data can come from the university's office of general counsel, or from information gathered from student work that is the subject of a disciplinary hearing. With this valuable information at hand, the advisory committee can then be used to develop a guide that faculty can use to develop assignments that can lower the incidence of plagiarism. Workshops can be offered on assignment development, and faculty teams can work together to create sample assignments that are discipline-specific. All of this requires an institutional commitment to reducing the incidence of plagiarism so as to protect the institutions credentialing ability.

There exist some good models in this regard. The University of Wisconsin-Madison offers coaching through its Writing across the Curriculum initiative. On their website, they offer some guidelines for "Designing Activities and Assignments to Discourage Plagiarism" (https://writing.wisc.edu/wac/node/55). Bates College offers similar guidelines aimed for assignments in the sciences (http://abacus.bates.edu/cbb/index0c91.html?q=node/130). At Indiana University, the emphasis is placed not only on assignments but also on syllabus design and grading criteria (http://citl.indiana.edu/consultations/teaching_writing/plagiarism.php). New York University's Task Force on Best Practices in Student Performance Assessment (Fall 2009) published a report that included some sample grading rubrics for a variety of academic disciplines that address plagiarism prevention by giving points for good uses of source materials. These rubrics remain good examples today. (https://www.nyu.edu/content/dam/nyu/facultyGovernance/documents/RepAcadInt113009.pdf).

There is much that an academic institution can do to safeguard its ability to credential its graduates. As more and more courses are offered online, there are more opportunities for students to engage in cheating. But just as technology has made available more opportunities for cyber cheating, technology has also made available more tools to combat plagiarism. And while deterrence can be effective, coupling deterrence with a more institutionalized approach using dissuasion and diagnostic methods hold the most promise for combatting academic dishonesty in this changing learning landscape.

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# Examining the Impacts of Social Media Engagement on Learners Motivation in MOOCs

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**Abstract:** The rapid development of online learning has attracted significant attention, in particular, the development of Massive Online Open Courses (MOOCs). Despite the extensive publicity and popularity, there are many recurring issues and problems raised in the academic literature, one of which is the consistently high dropout rate of MOOC learners. From prior studies on the subject, motivation is a key factor if higher uptake and completion of MOOCs is to be achieved. Increasingly, thousands of learners use MOOCs, each of whom has their diverse motivation. Thus, identifying how course design can motivate students is of paramount importance in stimulating and sustaining online learning behaviour, increase retention and completion rates of students. Currently, there are relatively few studies that address learner motivation in MOOCs. In order to build further understanding, the goals of the proposed research are: (a) to examine how engagement with social media affects learner motivation within a MOOC; (b) to find out if early engagement on social media before the course begins will motivate learners to start the course and (c) to find out if there are differences between learners' who engaged in social media and those who do not in terms of motivational levels, course engagement, achievement and completion rate. Learners who do not engage in social media will serve as the control group. The study will apply a mixed methods approach, collecting data via questionnaires and course platform tools. Motivation will be measured using modified Situational Intrinsic Motivational Scale (SIMS) questionnaires, based on the framework of Self-Determination Theory. The experimental stage of the study will be conducted within the context of an Entrepreneurship and Innovation MOOC, run on Canvas Platform. Results from this study will give a deeper insight into the effects of social media engagement on learner motivation, achievement, course participation and completion in MOOCs. The results are expected to shed light on the potentials of social media in improving online learning. Also, the study will assist future designers of MOOCs by providing deeper understanding of motivational effects of social media in MOOCs and help in properly defining their roles in online learning.

**Keywords**: online learning, learner motivation, social media

## 1. Introduction

Massive Online Open Courses (MOOCs) are free and sometimes paid, open access online courses that are offered to large audience and through distance learning (Bis, 2013). Over the years it has attracted attention from the media, educational institutions, professional bodies and the public sector (Yuan and Powell, 2013). Just as the name entails, MOOC in comparison with most online courses are massive and distributed across different educational platforms (Canvas Network, Future learn, Coursera, Edx, iversity Udacity, OpenClassrooms, OpenHPI, Eliademy, and Peer to Peer University, Open2Study, Coursmos etc). Two distinct pedagogical directions drive MOOC arising from different ideology. A cMOOC emphasizes the connectivism theory: which emphasizes collaboration, sharing and building knowledge within a community of people. The connectivist vision is best explained by its visionaries such as George Siemens who talks about open online learning as emphasizing *"creativity, autonomy and social network learning ", or* Steven Downes, whose new book on connective knowledge describe learning as "*the creation and removal of connections between the entities, or the adjustment of the strength of those connections. A learning theory is, literally, a theory describing how these connections are created or adjusted*."(Downes, 2012). Meanwhile xMOOCs follow a more behaviourist approach and are associated mostly with these large platform provider's edX, Udacity and Coursera (Bis 2013; Li Yuan and Stephen Powell, 2013).

MOOC can be seen as an extension of existing online learning approaches regarding open access to courses and scalability which offer an opportunity to think again about new business models that include elements of open education. Such thinking made many institutions to start engaging and experimenting with MOOCs, for the purpose of expanding access, branding and marketing, as well as the potential of developing new streams of revenue (Li Yuan and Stephen Powell 2013). In collaboration with many prestigious universities, Udacity, iversty, NovoEd and Coursera have also launched online courses for free and for some courses charge a fee for certification. For instance, Udacity and Georgia Institute of Technology, partnered with AT&T (A USA base telecommunication company) to offer full master's degree program costing $7,000, a fraction of its normal tuition (Revolvy, 2016). In May 2013 Coursera announced free e-books for some courses in partnership with Chegg, an online textbook-rental company. Students would use Chegg's e-reader, which limits copying and printing, and could also use the book only while enrolled in the class (New Jake, 2013).

Despite the advantages of MOOCs, one of the major issues frequently raised in both academic literature and the press is the consistently high dropout rate of the learners (Onah et al, 2014; Yang et al, 2015). Although thousands of participants enroll in these courses, the completion rates (defined as the percentage of enrolled students who completed the course) ranges from 0.7% to 52.1%, with a median value of 12.6 % (Jordan, 2014). Jordan further reported that the first and second weeks are critical in achieving student engagement, after which the proportion of active students and those submitting assessments levels out, with less than 3% difference between them? Reports have also shown that a low completion rate may not be necessary negative in the context of MOOCs (Kizilcec, 2013; Pardos et al, 2013; Veeramachaneni et al, 2013 for the fact that those who register for the same course in MOOC can have very diverse motivations and goals (Wang, 2014). Anderson (2013) also pointed out that, many MOOC participants enroll in courses with no intentions of completing the course but only to satisfy their initial curiosities.

As retention issues are becoming crucial in MOOCs, lots of researchers now emphasize that lack of collaboration, social interactions, and sense of community in online learning are major causes of attrition in MOOCs. Most studies have also shown that a high level of motivation is required for the completion of distance learning programmes including MOOCs (Khalil and Ebner, 2014; Knowles and Kerkman, 2007). Consequently, most instructors are now keen to encourage high levels of motivation in their students and look for ways to determine what motivates them to learn (Murray, 2013). Presently, most MOOCs platforms are restricted to playing videos, having discussion forums, sending announcement and there are not much support for social activities (Saijing et al, 2016). To solve this problem, most MOOCs instructors are now cultivating the active learning environment, by often incorporating a variety of external tools, such as Google Plus, Facebook, Twitter etc. into their MOOCs (Fidalgo, 2014; Ventura, 2014). However, these creativities are yet to present comprehensive studies on how the use of social media impacts on learners' motivation and the effect of such motivations on their MOOC engagement and retention. Therefore, finding innovative ways of enhancing motivation is imperative in giving us deeper insights that could help provide further understanding of motivational effects through the use of social media in MOOCs. Thus, identifying how course design can motivate students is of principal importance in stimulating and sustaining online learning behavior which is the key factor and a problem that this study intend to address. Therefore, this study is aimed at investigating whether using social media as a supportive interphase within a MOOC has motivational effects. Furthermore, the study will also examine whether there are differences between learners' who engaged in social media and those who do not in terms of motivational levels, course engagement, achievement and completion rate. The results from the research will provide better insights that will help instructors and students utilize social media to enhance user engagement and retention.

## 2. Literature review

### 2.1 Social networks and MOOCs

Research has shown that social networking tools have the potential to become one of the strengths of effective MOOCs since they boost interaction, the exchange of ideas and the build-up of personal learning networks with strong motivational element (Fidalgo et al, 2014; Ventura et al, 2014). Williams et al (2011) also reported that interactions in MOOCs help students to develop their ideas, express themselves, establish a presence and make thoughtful long-term relationships. Therefore, the lack of prompt and clear feedback from the instructor or fellow learners can also contribute to the student's feelings of frustration which can lead to dropping out. Bryant (2015) reported that for MOOCs to be considered value spaces for learning, they will need to adopt aspects of the earlier connectivist MOOCs (cMOOC) and reintroduce social elements. Many researchers have described social elements as a key to self-directed learning (Boucouvalas 2009). Furthermore in referring to online learning environment, Krejins et al (2002) and Jochems (2002) identified two drawbacks for social learning: "*the assumption that social interaction can be taken for granted and that it will automatically happen"* and "*forgetting the social –psychological/social dimension of social interaction that is salient in non –task contexts*". Because of these shortcomings that are broadly recognised in xMOOCs, the President of Stanford University was quoted as saying "*When l think about MOOCs. The advantage-the ability to prepare a course and offer it without personal interaction- -is what makes them inexpensive and makes them very limited*."(Jaschik, 2015). In order to address these problems, Purser et al (2013) suggested that by encouraging students to connect with each other before the MOOC course began, using social media sites like Twitter, Google+ and blogging, "the sort of socially networked 'peeragogy' model of open online education" can support learning and boost motivation.

### 2.2 Motivation and online learning

The concept of motivation is recognized as crucial to learning and learning outcomes especially online (Wang, 2014). Studies have shown that beyond just learning goals, MOOC students have established varied motivational patterns (Xiong, 2015). Although MOOCs are a relatively new addition to the field of online learning, the construct of learner motivation has long been seen as essential to learning and learning outcomes (Wang, 2014). Both researchers in academia and journalist have identified the high rate of drop out of MOOC student (Anderson, 2013; Carr, 2012; De Waard et al, 2011; Knox et al, 2012; Pappano, 2012). However, doubts have been cast whether completing the course assignments is necessary for MOOC participants (Fini, 2009; Mcauley et al, 2010). As Anderson (2013) emphasized, many MOOC learners enrol in courses just to satisfy their initial interest but have no intention in completing the course. According to Wang (2014) course completion rate is by no means the only important outcome, but it has become one of the most discussed metrics in the MOOC environment. Many motivational theorists have also argued that intrinsic motivation is sustained by learning goal (Deci and Ryan, 1985; Xiong et al, 2015). According to Ryan and Deci (2000), intrinsic motivation refers to executing a learning activity out of one's inherent interests, whereas extrinsic motivation implies one intends to gain a separate outcome. MOOC students apparently consist of learners possessing each or both types of motivation (Wang 2014).Intrinsic motivation has for some time now been acclaimed to predict effective learning (Keller and Suzuki 2004). Furthermore, Keller and Suzuki (2004) emphasized that students of E-learning platforms face more motivational challenges because they have to work independently at a distance in most cases. As a result these, across many e-learning platforms, a relatively high dropout rates have been consistently observed (Adamopoulos, 2013; Jordan, 2013; Onah et al, 2014).

### 2.3 Student engagement in MOOCs

According to Coates, 2007; Chen, Robinson & Hullinger, (2008), student engagement research often focuses on on-campus and face-to-face instructional activities but some scholars have considered the relationship between engagement and outcomes in on-line courses in learning management systems (Beer et al., 2010) and in social networks Thoms and Eryilmaz (2014). For instance, Robinson and Hullinger (2008) used a version of the National Survey of Student Engagement (NSSE) to explore variations in engagement of students enrolled in at least one completely on-line course. The outcomes suggest variations in engagement are associated with students' academic performance, academic major, and age, and faculty creating "*purposeful course designs that promote interaction, participation, and communication in the online learning environment*" (Robinson & Hullinger, 2008, p.107). In many studies in MOOCs, engagement rate was calculated by analysing indicators of engagement such as the use of discussion forums, assignments, quiz completion, and videos watched (Salmon et al, 2015; Xie et al, 2011; Xiong et al, 2013).

Apart from MOOCs engagement measure, the completion rate is an important metric that will be measured in this study. In the case of completion rate, many researchers have proposed several ways of measuring completion rates. For instance Perna et al., (2014) stated that access rates offer a different view of the potential education benefits of courses than completion rates. Access rate per user, is calculated as the sum of the number of times a user accessed any of the defined types of activities offered in the course, divided by the number of users. This indicator recognizes that a user may access a lecture and some assessments multiple times. Ruby et al (2015) also defined completion rates as the percentage of registrants accessing a lecture in the last week or module of a course and refer to them as "lecture completion rates" to distinguish them from completion rates of assessment activities.

## 3. Methodology and progress

### 3.1 Research context

The starting point for this research is based on the "Entrepreneur and Innovation" MOOC which was offered through Canvas network by University of Greenwich in May 2015. The MOOC was designed to be student-centric and the expectation was that student would independently work through the course material and form groups on the course forum. However, the completion rate was not different from the norm of less than 10% (Bacon et al, 2015). Based on these, a new pedagogical model is now proposed which is aimed at encouraging students to become an active part of a social network such as Facebook, Google Hangout and WhatsApp. The aim is that this approach will stimulate interaction, the exchange of ideas and the building up of pro-active individual learning incorporating the social and motivational component.

The second MOOC also titled"Entrepreneur and Innovation" will span for 6 continuous weeks with assignments and lecture videos. Students will be expected to participate in forum discussions accompanying weekly course releases. Those who indicate interest to engage in social media (Facebook, Google Hangout and WhatsApp) will be expected to interact and discuss weekly topics and share information.

The main Ph.D. project will involve mixed method that is both qualitative and quantitative (Bryan, 2012). Once the course is advertised on the Course provider's website, three social media groups will be created - Facebook, Google Hangout, and WhatsApp. Information on the research purpose i.e. consent letters will be advertised on the course platform. Students who indicate interest in the research will be requested in the letter to have or open a Facebook and Google account and a WhatsApp mobile number will be provided. The privacy setting on the Facebook will only allow members of the group to post and make comments. The posts will not be visible to others outside of the group (Ventura et al, 2014). Those who do not use the social media will be the control group. Course topics, discussion activities and messages will be sent across the social media platforms throughout the course (Pittenger and Doering, 2010; Ventura, 2014). Students are expected to interact by expressing their opinions on the weekly course topics, sharing resources, links and commenting on others' contributions as related to the course (Baird and Fisher 2013;Bryant, 2015).

### 3.2 Survey

Given the diverse motivations of MOOC learners and the current concern in course completion and other measures of engagement, this proposed research intends to expand our understanding of MOOC learners and would like to answer the research questions; (1) Does engagement in social media before the course begins, motivate student to start the course? (2) Are there differences between learners' who engaged in social media and those who do not in terms of motivational levels, course engagement, achievement and completion rate?

Therefore, two categories of motivational aspects including extrinsic and intrinsic motivation will be taken into account in this initial research attempt. The MOOC-specific items include course engagement, achievement; completion rate whereas the motivational subscales include intrinsic motivation, identified regulation, external regulation and amotivation. Participants will be asked to respond to these questionnaires in relation to their engagement in the course. Each of the four motivation subtypes will be measured using 5-point Likert scales responses. For each participant, these subscale scores will be used to calculate a single motivation score called the Self-Determination Index (SDI) (Deci and Ryan, 1985). This follows the weighted calculation described and used in previous research (García et al, 2015; Jang and Chen, 2010; Vallerand and Koestner, 2008; Vallerand and Ratelle, 2002).

### 3.3 Questionnaires

A questionnaire will be developed, validated and ethically approved to obtain data by using a standards procedure which include item development and testing (Bryan 2012). Three set of questionnaires will be used to obtain data for this study and this will be administered via the course site. Two of the questionnaires (course registration and exit questionnaire) consist of 5 point Likert scale point of 1-5 of strongly agree (5) and strongly disagree (1) and open-ended/comments responses. The Course Registration Questionnaire will be administered as soon as students signs up. Information on learners' demography, intentions and the use of social media will be obtained. The second questionnaire is the Motivational Questionnaire. This questionnaire will be administered at week three of the MOOC course. The modified questionnaire is based on the Situational Motivational Scale (SIMS) developed by Guay, Vallerand and Blanchard (2000) which is based on the framework of Self Determination Theory (SDT). Lastly, the Exit and Course Evaluation Questionnaire will be administered at the end of the course and to students who exit early to obtain information on course, social media experiences, and effects of early engagement on social media.

### 3.4 Data analysis

Data on MOOC course activities (engagement rate, achievement-scores and completion rate) will be obtained from Canvas dashboard. Specifically, drawing from past research in monitoring engagement within online learning, this project will analyse indicators of engagement such as the use of discussion forums, assignments, quiz completion, and videos watched (Ming and Ming 2012 ;Salmon et al, 2015; Xie et al, 2011;Xiong et al, 2015). SIMS questionnaire will be used to obtain data on motivational levels of learners. All the data mentioned above will be collected and subjected to statistical analysis. SSPS will also be applied to visualize and carry out statistical analysis of the data to answer the research questions and test the hypothesis. Statistical test like MACOVA and correlation analysis will be used to test the significance differences between groups and determine relationships among the variables (Social Media and No Social Media-control group). Data on course and social media experiences and opinions will be analyse using Deductive Approach to group the data/analyse and look at the similarities and differences.

## 4. Proposed contribution

We intend to run the MOOC in Sept 2016 hoping for several hundred participants. We anticipate significant percentage will engage with social media on registration for the MOOC and that this will have an impact on both the motivation of those learners and their retention within the MOOC. The data collected and analysed will then provide further information informing the future development of MOOCs in combination with social media.

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# Pre-Service Mathematics Teachers' Designing Teaching Supported by GeoGebra

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**Abstract:** The article reports on a design experiment aimed at designing a part of a mathematics education course focused on GeoGebra with the goal to develop student teachers' technological pedagogical and content knowledge. Based on results gained in previous stages of the design experiment reported elsewhere for Sample 1, more emphasis was laid on personal discussions and changes were made in the e-learning part. Student teachers in Sample 2 were given explicit guidelines to prepare proposals for teaching and to peer evaluate each other's work in LMS Moodle module Workshop. The research data consist of student teachers' ($n_1$ = 24, $n_2$ = 40) proposals for teaching supported by GeoGebra and written peer evaluations. The data were analysed in a qualitative way using modified existing frameworks and our Quality Index and then elaborated quantitatively. The results show a marked trend towards proposals of teaching in which student teachers use the potential of GeoGebra, mainly its dynamic features, and engage pupils actively with technology. There are no low quality proposals for Sample 2. On the other hand, there was no change in the types of goals student teachers set.

**Keywords:** technological pedagogical and content knowledge, GeoGebra, LMS Moodle, peer evaluation

## 1. Introduction

The aims of our programme for future mathematics teachers at the lower and upper-secondary schools include, among others, to teach student teachers to (a) design teaching that promotes pupils' active learning and (b) design teaching supported by technology. For the latter goal, we use GeoGebra as it promotes mathematical connections among branches of mathematics (algebra, geometry, calculus, statistics, etc.) and highlights multiple representations (equations, graphs, tables). Moreover, it is free, it runs in different operating systems and in different devices. We devote a part of our mathematics education course to GeoGebra and its use in teaching. Student teachers are, among others, to write a proposal for teaching (here Project) supported by GeoGebra. After the first round of teaching GeoGebra within the course in 2013 and the analysis of student teachers' Projects, it transpired that they mostly used static figures and proposed instructive teaching. Thus, we made some changes in our teaching in 2014.

First, we included more in-person discussion and second, we introduced peer evaluation of Projects in LMS Moodle via module Workshop. Studies showed positive effects of peer evaluation on university students in terms of understanding the content, increased personal motivation and awareness of the evaluation process (see Ozogul, Olina and Sullivan, 2006, for examples). In their study, Ozogul, Olina and Sulivan found the biggest effect on the quality of the final lesson plans in the teacher-evaluation group but significant improvements were also found in the self-evaluation and peer-evaluation groups. For these reasons and also because we believe that peer evaluation experience is useful for future teachers as such, we included it in our teaching, too.

When we analysed student teachers' Projects (Sample 1 here), we concluded that most of them did not use GeoGebra to its full potential and that their authors did not make use of principles of teaching mathematics promoted in the course. We decided yet again to make changes in our teaching in years 2015 and 2016 (Sample 2 here). The article will focus on the effects this changes had on the nature of Projects for Sample 2 students.

Note: We will use the term 'students' for student teachers and 'pupils' for primary and secondary pupils and an acronym GG for GeoGebra.

## 2. Theoretical framework

### 2.1 Pupils' engagement in mathematics

According to The National Research Council report, the effectiveness of mathematics teaching and learning is "a function of teachers' knowledge and use of mathematical content, teachers' attention to and handling of students, and students' engagement in and use of mathematical tasks." (2001, p. 315). In other words, pupils' learning of mathematics is highly affected by the types of tasks that teachers present and the kind of discourse that they orchestrate when implementing the tasks in lessons (Hiebert et al, 2003). In this implementation, pupils' engagement in gaining mathematical knowledge is stressed. For example, the concept of *opportunity to learn* is defined as the "circumstances that allow students to engage in and spend time on academic tasks such as working on problems, exploring situations and gathering data, listening to explanations, reading texts, or conjecturing and justifying" (The National Research Council, 2001, p. 333). It includes "considerations of students' entry knowledge, the nature and purpose of the tasks and activities, the likelihood of engagement, and so on" (Hiebert and Grouws, 2007, p. 379) and is seen as the single most important predictor of pupils' achievement. The same applies to teaching with the help of technology; pupils should actively engage with technology to solve mathematical problems (e.g., Harris, Grandgenett, and Hofer, 2010; Agyei and Voogt, 2015; Wentworth and Monroe, 2011).

## 2.2 TPACK

To determine the type of knowledge and skills teachers need to integrate technology into their teaching so that pupils actively engage with tasks, Mishra and Koehler (2006) introduced the technological pedagogical content knowledge (TPACK) framework. They argue that effective ICT integration for teaching specific content requires understanding the relationships between three primary forms of knowledge that a teacher needs: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK), as well as the interplay and intersections: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge between them. The framework explicitly acknowledges that effective pedagogical use of technology is deeply influenced by the content domain in which the knowledge types are situated.

> *[TPACK is] the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (Mishra and Koehler, 2006, p. 1029)*

Thus, we can say that in our course on GG we strive to develop elements of students' TPACK.

## 2.3 Lesson plans as a measure of TPACK

Lesson plans are at the core of teachers' work. The task to make a lesson plan is thus relevant to them and is often used in research to assess various aspects of (student) teachers' beliefs and knowledge, e.g., their pedagogical content knowledge (Anhalt, Ward, and Vinson, 2006) or their understanding of inquiry teaching (Wang, and Lin, 2008). Lessons plans are also analysed in order to assess their authors' TPACK. An example is Harris, Grandgenett and Hofer's (2010) Technology Integration Assessment Rubric (section 3.2). Similarly, Bowers and Stephens (2011) describe a rubric for assessing the quality of student teachers' lesson plans made after 18 lessons of work with the Geometer's Sketchpad. They determined for each plan:

> *the degree to which the student demonstrated TK, TCK, TPK, or TPACK with the assumption that these types of knowledge are additive. […] If a student demonstrated a good use of the technology to examine a particular content area but did not include any particular presentation affordances, such as use of colour or scripting tools, then he or she was characterized as having knowledge at the level of TCK, but not TPACK. (p. 293)*

Agyei and Voogt (2015) analysed lesson plans, among others, to see the impact of a course on the TPACK competencies for spreadsheet integration. Ozogul, Olina and Sullivan (2006) developed a 15-item lesson plan rubric organised in four sections: (1) standards and objectives, (2) technology and materials, (3) lesson procedures, and (4) assessment. Wentworth and Monroe (2011) suggest a four item rubric for evaluating (student) teachers' TPACK when analysing their reports of teaching (student teachers and teachers were informed about the items before writing plans):

> *(a) The lesson involves the students themselves in actively using technology; (b) the technology is integral, not peripheral, to the learning activity; (c) the lesson focuses on the mathematical*

*concept, not the technology; and (d) the technology facilitates learning activities that would be more difficult or impossible for the students to accomplish without the technology. (p. 264)*

### 2.4 Design experiment on the use of GG in teaching and our previous work

In 2013, we started a design experiment (Cobb et al., 2003) to design a part of the mathematics education course which would equip students with ways of teaching mathematics supported by GG. The course has been taught by the second author who strives to promote such teaching of mathematics which places emphasis on pupils' engagement with tasks. Rather than presenting students with ideas of the effective use of GG, we prepared worksheets with tasks on geometry and functions in which, we hoped, they will see the advantages and pitfalls of GG for themselves. The teaching experiment comprised contact lessons and home study. In the first stage of the design experiment, there were 12 lessons, in the subsequent ones only 8 and students were asked to solve worksheets tasks at home. Finally, students were given reading on using GG in teaching and on the nature of computer geometry and a task to make a proposal for teaching supported by GG (section 3.1).

In this article, we focus on the difference in the quality of students' Projects for Sample 1 (year 2014) and Sample 2 (years 2015 and 2016). The analysis of Sample 1 Projects showed that many did not meet our expectations. Namely (Robová and Vondrová, 2015):

- Minority of Projects included dynamic features of GG (mostly using sliders for functions).
- Many tasks could be solved without GG; it only made solutions more illustrative and quicker.
- Most of the Projects were rated as TCK; students could use GG for developing their mathematical knowledge but did not present ways in which GG can support pupils' learning.
- No Project included tasks leading pupils towards the level of argumentation and proof.
- Even though the students were asked to devise teaching in which pupils work autonomously, the Projects of about half of them were instructive; they gave pupils tasks which led them step by step towards the goal and provided them with explicit instructions for work.
- Students' peer evaluations of the Projects were quite superficial and general.

We concluded that "a good choice of tasks [in our teaching of GG] must be accompanied by a more explicit discussion about the features of GG use in teaching" (Robová and Vondrová, 2015, p. 2402) as such a discussion can "guide students' own metacognitive processes as they reflect on their learning and development efforts" (Bowers and Stephens, 2011, p. 301). Following Bowers and Stephens' (2011) study in which the worst results were reached by students who chose the completely online version of the course while the best were reached by students in the "in person" course, we decided to use face-to-face discussion. It was more explicitly focused on the differences between computer and paper geometry (Laborde, 1998) and on the merits and pitfalls of GG. When the students did not bring these topics up, the course leader did so and made sure that they were thoroughly discussed. Another implication of our previous study was that the instructions for peer evaluation must be more specific to provide students with guidance by drawing their attention to measures of instructional quality. Finally, similarly to Wentworth and Monroe's (2011) study, we augmented the assignment of the task by explicit criteria for the assessment of Projects.

In this contribution, we enhance our previous work in two ways. First, we will add more data to Sample 1 as in (Robová and Vondrová, 2015) about half of the Projects were analysed. Second, we compare results for Sample 1 and Sample 2 and look for causes of differences in the adjustment we made to our teaching.

## 3. Methodology

We pose two research questions:

- Are there any differences in the quality of Projects following the adjustment to teaching made for Sample 2 students?
- Are there any differences in the quality of Projects based on their topic (functions or geometry)?

### 3.1 The task and the samples

Both Sample 1 and 2 students underwent 8 lessons of the teaching experiment after which they were randomly assigned functions or geometry as the area from which they should choose a concrete topic for their Projects (see tab. 1). The assignment was as follows: "Make a proposal for teaching a topic at a secondary school. Suggest problems and tasks which would lead to pupils' autonomous investigation supported by GG. Use problems for which the added value of GG is clear." The Project was to include tasks with comments, their solutions including GG figures, the goal(s) of activities, pupils' prior CK and TK, their expected problems and a suggestion of their remedy, suggestions for tasks implementation, etc. For Sample 2, this assignment was augmented: "When preparing the Project, it might help you to know criteria which will be used for its assessment: a) Type of goals [examples given], b) Measure of pupils' autonomy [examples given], c) Added value of GG, d) Use of dynamic features of GG, e) Overall judgement of tasks with respect to the suggested time frame and the goals of the project."

The students submitted Projects via a LMS Moodle module Workshop. Afterwards, LMS Moodle randomly assigned them their peers' Projects to evaluate. For Sample 1, the instructions were: "Evaluate the Project from the point of view of appropriate use of GG for the development of secondary mathematics knowledge." For Sample 2, they were augmented by specific points [a) to e) above] which were known to the students from the Project assignment.

**Table 1:** Topics of projects

| | Functions<br>Males / Females | Geometry<br>Males / Females | Total<br>Males / Females | Peer evaluations |
|---|---|---|---|---|
| Sample 1 | 11 (45,8 %)<br>5 / 6 | 13 (54,2 %)<br>7 / 6 | 24<br>12 / 12 | 43 |
| Sample 2 | 18 (45,0 %)<br>4 / 14 | 22 (55,0 %)<br>8 / 14 | 40<br>12 / 28 | 117 |

The two samples consist of students studying to be mathematics teachers at the lower and upper secondary schools at the second author's faculty. They were all students in the appropriate year group (first year of a two-year master programme). There was no selection. As far as we can tell, they did not differ in mathematical knowledge; they all held a bachelor degree in mathematics mostly from the same faculty. At the time, they all had 4-week teaching experience within the teaching practice. About 10 % of them worked as part-time teachers during their studies. They all had good TK acquired in a special bachelor course. They were able to work in GG, they could orientate themselves in its workspace, they knew where to find required tools and how to use them.

## 3.2 Analysis of data

The data consist of text files describing the Project and GG figures with tasks and their solutions. We used a mixture of measures to assess the nature and quality of Projects.

Harris, Grandgenett and Hofer's (2010) Technology Integration Assessment Rubric was designed for analysing lesson plans made by student teachers and thus it is useful for us. The plan is assigned 1 to 4 points in four measures: 'Curriculum Goals and Technologies' (curriculum-based technology use), 'Technology Selection(s)' (compatibility with curriculum goals and instructional strategies), 'Instructional Strategies and Technologies' (using technology in teaching/learning), 'Fit' (content, pedagogy and technology together). We did not use the first two measures as the Projects were aligned with the curriculum and GG was prescribed. Instead, we used 'Types of Goals' measure which concern explicitly stated goals: Content Goals (related to specific mathematical topics), Skill Goals (related to the development of skills), General Competence Goals (outside of mathematics). The two remaining measures from the Rubric were used: 'Instructional strategies and technologies' was coded from I1 (technology use does not support instructional strategies) to I4 (optimally supports); 'Fit' was coded from F1 (content, instructional strategies and technology do not fit together with the instructional plan) to F4 (fit together strongly).

Next, we were inspired by Bowers and Stephens' (2011) rubric (see section 2.3) which we modified. While their plans consisted of one sketch, our students proposed several tasks for more than one lesson. Thus, we had to assess what feature prevailed in Projects. Moreover, we did not fully embrace the authors' assertion that the elements of TPACK are additive, thus introducing a kind of hierarchy which, in our opinion, is not in the original model of TPACK. Finally, as the authors do not provide examples of projects coded TPK, we used our own modification. Instead of TPK and TPACK codes, we used TPACK1 and TPACK2. The former means that the student demonstrates an understanding of using technology for more informative, quick and effective teaching of mathematics. Tasks proposed make understanding easier but do not lead to argumentation. The latter means that he/she realises the potential of GG for developing mathematical reasoning up to the level of argumentation and proof.

Next, we made use of a Tool Competence Model for symbolic calculators suggested by Weigand (2011). The model consists of Static Mode (producing static representations, SM), Dynamic Mode (creating dynamic representations, DM) and Multiple Mode (using the ICT tool as a multiple representational tool). In order to account for the complexity of Projects, we also used code DM- meaning that dynamic features were used in one or two problems, but otherwise the use of GG was static.

Finally, to capture to what extent Projects engaged pupils with technology (see also Wentworth and Monroe, 2011), we used the measure of hypothetical pupils' role in gaining knowledge (from A1 – pupils are given step by step instructions, to A4 – it is up to pupils to decide how they will solve the tasks).

Each Project was peer evaluated in writing by 1 to 4 students (depending on the automatic allocation of Projects by LMS Moodle). In evaluations, we followed to what extent they commented on the phenomena which we identified as important for TPACK and used for the analysis of Projects: E1 – a shallow evaluation, a student does not comment on obvious deficiencies or merits of the Project, his/her comments are general; E2 – he/she comments on some aspect only, such as the content; E3 – he/she comments on both positive and negative features, uses most measures; E4 – expert evaluation.

The two authors coded 11 projects independently and discussed their coding until 100% agreement was reached. The rest of the projects was coded by one of them. In this manner, each Project was allocated a set of codes (tab. 2). In order to compare the Projects of the two samples, we needed a kind of overall measure (see also Ozogul, Olina, and Sullivan, 2006). We used the results in Instructional strategies, Fit and Pupils' autonomy (1 for the lowest measure, 4 for the biggest) and Mode (0 point for SM, 1 for DM- and 2 for DM). Each Project was assigned a number which we called its Quality Index. Its minimum is 3 (I1+F1+A1+SM), maximum 14 (I4+F4+A4+DM).

**Table 2:** Example of coding projects

| Name | Topic | Goals | Instructional strategies | Fit | TPACK | Mode | Pupils' autonomy | Evaluation | Quality Index |
|---|---|---|---|---|---|---|---|---|---|
| Female 1 | Absolute value | Content | I2 | F2 | TCK | SM | A1 | E3, E2 | 5 |
| Female 2 | Congruence and similarity | Content, Skill | I2 | F2 | TCK | DM- | A3 | E1 | 8 |

When we compared the Quality Index with previously assigned codes TK, TCK or TPACK1 (we did not assign TPACK2 to any Project), we found out that TK and TCK matched the Index of 3 to 9 and TPACK the Index of 10 to 14. There were four Projects in which this did not hold. We reconsidered them and upgraded two to TPACK1 and downgraded the other two to TCK.

## 4. Results

### 4.1 Comparison of the nature of Projects in Sample 1 and Sample 2

There was no change in the types of goals students wanted to reach even though Sample 2 students were given hints about what types of goals they could pursue; if any, they mentioned the content goals, save for five Sample 2 students who mentioned the development of competence such as "the use of ICT for solving problems", "communication competence" or "development of independent solving of tasks". In the other measures, however, we can see a certain development.

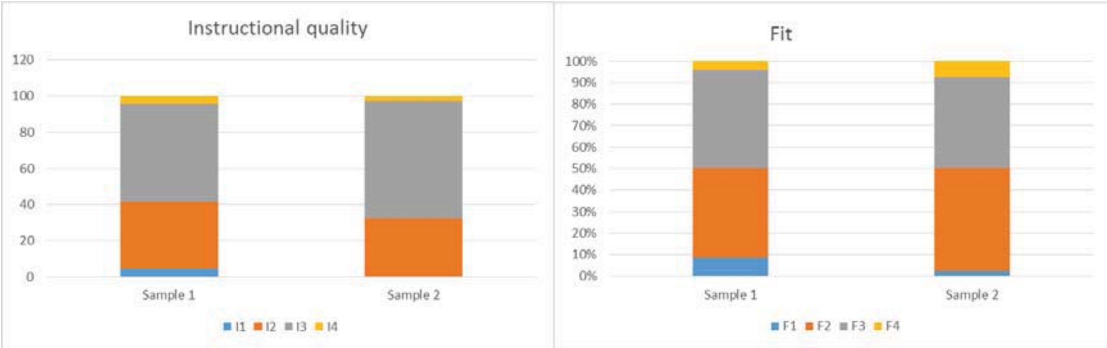


**Figure 1**: Instructional quality (left), Fit (right)

In fig. 1, we can see that in Sample 2 there were no Projects with the lowest instructional quality and there is a markedly bigger proportion of good instructional quality projects. More Sample 2 students' Projects were evaluated F4 rather than F3, and F2 rather than F1. An example of F1 from Sample 1 is the Project in which pupils should first find a definition of logarithmic function, discuss it and deduce from it that the graph of the inverse function can be received via line symmetry over $y = x$. They used GG to construct graphs of inverse functions (the tool of Line symmetry) to given exponential functions. The algebraic window of GG showed the equation of exponential functions and parametric equations of logarithmic functions which are unknown to secondary pupils. On the other hand, there is a F4 Project in which pupils gradually investigate relationship of an ellipse to a line $y = x - 1$, then a line $y = x + a$, where $a$ is a real number. Next they look for equations for tangent or outer lines of the given hyperbola going through the origin, etc. They use sliders and drag objects and at the same time, they do calculations to verify what they see on the screen.

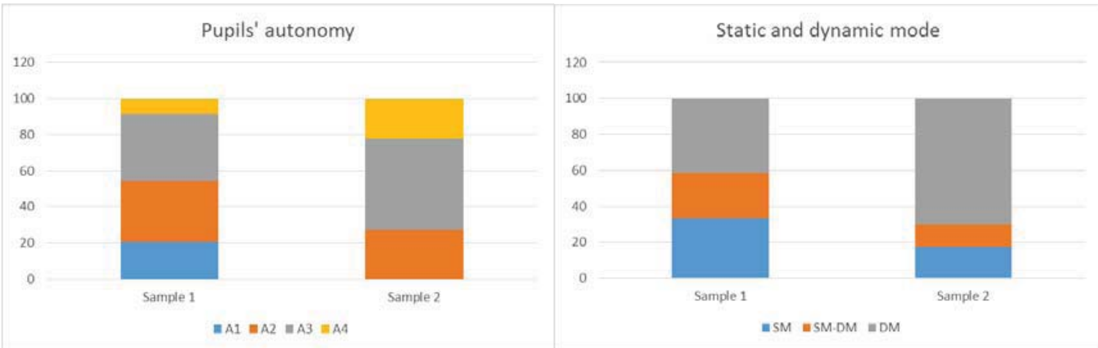


**Figure 2:** Pupils' autonomy (left), modes (right)

Fig. 2 shows that Sample 2 students put more emphasis on pupils' autonomy in solving the tasks. They planned to give them freedom to experiment and look for answers. There are no Projects with specific instructions which pupils should follow one by one as was the case for Sample 1 students. A big improvement can be seen in the use of dynamic features of GG. Nearly 75% of Sample 2 Projects make good use of it, whilst the number of Projects with static mode tasks only has dropped by half. An example of the static mode for Sample 1 is a Project in which pupils were to connect equations of functions and their graphs and thus only used GG as a graphing tool to check whether they were correct.

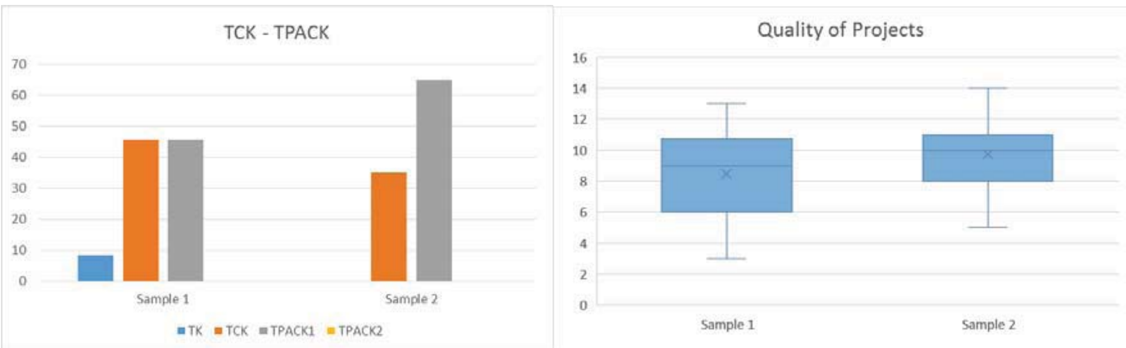


**Figure 3**: TPACK measure (left), quality index (right)

The measures in fig. 3 provide us with an overall picture. There is a marked improvement in TPACK1 which stems from the greater emphasis on pupils' autonomy and dynamic features of GG. There are no Projects in which the student only showed that he/she can use GG for solving problems but not for planning teaching. There are no Projects evaluated as TPACK2 which is in a way understandable because being able to use GG up to the level of mathematical argumentation and theoretical proof is very demanding and requires an experienced teacher.

Box-and-whiskers plots of the Quality Index (fig. 3, right) show a more accurate picture because it distinguishes among Projects better that three-item measure in fig. 3 left. The quality of Projects improved and there is not such a big spread in their quality. There are far less low-quality Projects in Sample 2. We cannot say for sure, but it is a fair guess that this was mainly caused by students knowing in advance the criteria with which their Projects would be evaluated.

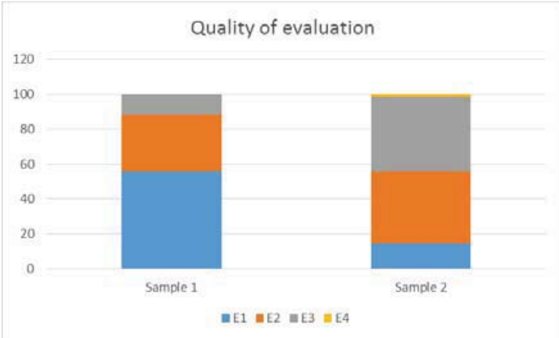


**Figure 4**: Quality of peer evaluations

Finally, we consider the nature of peer evaluations. There is a marked improvement for Sample 2 which we attribute to the points of view they were to consider when evaluating Projects. In one case the evaluation was even coded as an expert evaluation E4.

### 4.2 Nature of projects for geometry and functions in both samples

We were interested to see whether there were any differences in the quality of Projects caused by the nature of targeted mathematics. We put both samples together (in each sample, roughly the same number of students had a topic from functions or geometry, tab. 1). Fig. 5 shows that the arithmetic mean and median is roughly the same for the two groups. However, the spread is bigger for functions; students found it easier to use the potential of GG for a geometric topic. There were some Projects on functions of a lower quality than projects on Geometry. We can only speculate about the reasons. First, the causes might be in the nature of the mathematical topics themselves. There is a wealth of problems solved at the level of secondary school in which movement is used such as loci or properties of geometric shapes. Second, GG tool bar has mostly geometric tools available and thus it might be easier for students to think about their uses.

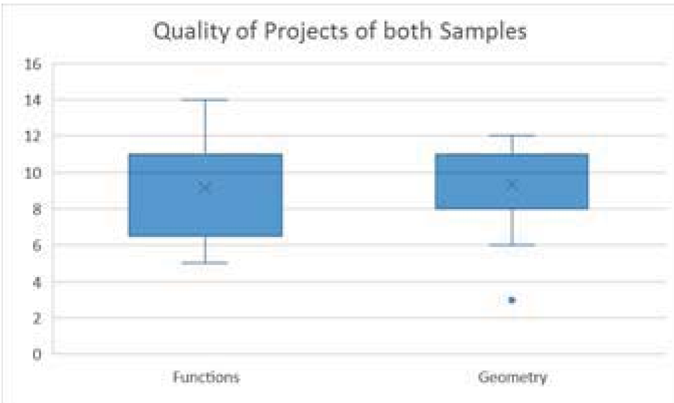


**Figure 5**: Quality Index for projects on functions and geometry

## 5. Discussion and conclusions

To sum up, following the changes consisting of a) providing students with more explicit discussions about GG and its use in teaching, b) telling them in advance what our criteria for evaluating Projects are, c) providing them with criteria for peer evaluations, we can see a marked improvement in the quality of their proposals for teaching. The low quality Projects disappeared and students focused more on pupils' engagement with GG when solving tasks and used dynamic features of GG.

On the other hand, even though the students were provided with example goals for Projects which also included goals to develop skills or general competence, they proposed teaching with content goals only. In a similar vein, Wentworth and Monroe (2011) studied students' ability to plan teaching with the help of spreadsheet and they also shared the criteria to be used for evaluation beforehand. Students failed to account for one of them, namely they "struggled to use technology in an integral way and to design a task that would be more difficult to accomplish without technology" (p. 269). Wentworth and Monroe suggest more direct instruction: "The instructors should focus on the use of technology that allows candidates to think more deeply about the mathematics in ways they could not without the technology." (p. 271) The course for our students should, probably, concentrate more on the types of goals which teaching mathematics can pursue as such, not only with the help of technology.

In common to our previous study, we can conclude that "it is far from straightforward that the pre-service teachers will connect their technology, content and pedagogical knowledge without deliberate support from the educator" (Robová and Vondrová, 2015, p. 2041). Even though Sample 2 students proposed somewhat better quality Projects, we should strive for better results. Moreover, we do not know whether the students will be able to carry out teaching in the way they plan it. It would be desirable if the students could teach the lesson they planned. This is not possible as schools where students take their teaching practice are often not equipped with PC laboratory and, moreover, they have to teach what is planned according to the curriculum. Agyei and Voogt (2015) found a positive effect of peer teaching of students in the course on TPACK scores. They explain it by saying that "these pre-service teachers engaged themselves in additional planning and preparation needed to teach the technological lessons. This is consistent with other studies […] that acknowledge the importance of applying teachers' competencies about technology integration in authentic settings" (p. 621). Peer teaching might be plausible in our course.

## Acknowledgements

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# Wikis in ICT and ICT in Wikis: A Blended Strategy to Engage Students in Secondary Education

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**Abstract:** Wikis in ICT and ICT in Wikis consist of a "blended" strategy that engages students in Secondary Education. It seems that Wikis form a "promising" environment in Secondary Education and particularly in the obligator course of Information and Communication Technologies (ICT) course. While the concept of Wikis is part of the curriculum in ICT courses in high school (gymnasium), it can also be used as a complementary e-tool which supports the class teacher/facilitator. Here is an implementation of a "blended" strategy combining face-to-face learning with web-based and distance learning. As of 2011, the ICT course is an obligatory, two hour course each week in Greek Pilot Gymnasium curricula among experimental schools and is mainly a project-based. This course focuses on, "ICT literacy," which describes the students' ability to solve problems and participate in our society of modern knowledge with the use of digital technologies, to use communication tools and network services for access, management, embedding, evaluation and information communication. Our rearch focuses on the exploitation of Wikis in the ICT course. During the last three years, Wikis are used in the context of ICT course in the Experimental School of Aristotle University, Thessaloniki, Greece. Students of 13-15 years old participate in the Wiki of the class with their personal account and share material, collaborate, discuss, communicate with classmates and teacher. The ICT course is based on four issues: a) ICT as a scientific technological tool, b) ICT as a cognitive tool, c) ICT as a method to solve problems and d) ICT as a social phenomenon. Our empirical research has been implemented through observations, questionnaires and interviews in order to triangulate our results. The results have showed that Wikis give students the opportunities to develop skills and abilities related to ICT course curriculum and teacher's "blended" strategy engages them in their learning process. Since teaching of ICT literacy in high school is a clear laboratory educational process, each student's active participation can be considered as feasible. Interaction and collaboration between students, teachers and educational material are continually ecouraged. The Wiki of the class and the school computer-laboratory are the places where students can study, research, actively participate and collaborate in such a way that the exploratory and research approach of knowledge, interactive and collaborative learning and creativity are favoured and encouraged.

**Keywords:** ICT course, secondary education, Wiki, collaborative learning, blended learning, interaction

## 1. Introduction

The continual expansion of Information and Communication Technologies (ICT) combined with the increase of their availability in most of the countries and the development of access to Internet, have led teachers to design their teaching with the exploitation of ICT in educational praxis. Teaching is integrated with e-learning (Herrington, Reeves & Oliver, 2005).

Teaching in Secondary Education have limitations that come from the traditional educational methods. These limitations being the specific timeline of teaching, in a particular place, without having the possibility of a tailored personal learning curve which is appropriate for all students in consideration of their personal needs, talents, skills and competences. These limitations can be overcome with the use of online education and, more generally, the use of e-learning as a complementary tool in teaching. Today's reality is that in high school - and particularly in the context of the course of ICT- teachers have lessons of one hour per week (or two hours in the "pilot" curriculum that is implemented in Experimental Schools in Greece). This time given is never enough. Morever, although the course is mainly project-based and students' collaboration is a requirement, it is too difficult to implement it and this makes it necessary to exploit online learning. On top of that, students need flexibility and extra time to research the large amount of available information in order to spot the most valid and recent data for their work. Students search and focus not just to find information, but to gain scientific knowledge according to their assessments. This leads to the need of giving to students all the opportunities for gaining new knowledge, skills, and competences through constructivism (Steffe & Gale, 1995). Also, teachers expect to provide one more possibility of learning via peer to peer assessment in which students give informed feedback to one another's assignement. These can be achieved with ICT tools support, particularly with collaborative WEB2.0 tools. Today's students have the possibility to work and cooperate at their own pace, with their own way of learning and in a timeframe that is defined by themselves according to their needs, expectations and circumstances of daily life.

Wikis exploitation has a lot of benefits in teaching and learning (Tselios et al., 2011). Teamwork promotes active learning (Yan, 2008) and effective teaching. The scope of this paper is to explore the effectiveness and impact of using blended learning through the exploitation of Wikis in the Secondary Education ICT course. With our research we investigate:

- the necessity of teachers to implement not only technological issues but also pedagogical principles that can lead to revealing and entertaining teaching (Spanaka,2005),
- the level of impact of online collaborative activities when used as a complementary tool of teaching in the high school ICT course, focusing on the benefits of Wiki-based learning (choice of time and space for studying, personal studying pace, e.t.c.), as well as its technological features,
- the methods and approaches that students can choose to focus on with different criteria: studying, commenting and answering questions.

The structure of the paper contains the following sections: a) first, a literature review of Wikis presents research results from Wikis exploitation in educational process, b) the research methodology is analyzed c) these results are analyzed and discussed, and d) conclusions and future directions are drawn.

## 2. Literature review

Mainly for communication and collaboration practices and not for its technological features, Wiki is considered as a w*eb-based communication* and *collaboration tool*, which is more effective than other Web2.0 tools(Ma & Yuen, 2008). Karystinakis and Paraskeva (2013) emphasize that Wikis can be used in three different ways: *sharing material, collaborative production* and *public discussion***.** With this web-based tool teachers educate their students in an interactive way, supporting their learning and involving them in a creative educational process. Students develop skills of communication, edit information, share material, discuss, create collaboratively and become responsible and active group members. Kear et al. (2010) say that when students work on a Wiki they are introduced to the process of creating content of a web-page and develop their creative abilities. Neumann & Hood (2009) have added that students gain skills of sythesizing information and verbal expression and creative flexibility by accepting others' improvements. Furthermore, students are not ''pathetic collectors of knowledge'' (Sanden & Darragh, 2011), because their collaborative learning increases the commitment they feel for the common activity and the expectation to help each other for protecting their group (Neumann & Hood, 2009).

Literature review shows that Wikis can be used in many different ways in education as: a) course management tools (Zorko, 2009) b) collaborative authoring tools (Kessler, 2009; Kost, 2011; Li & Zhu, 2013) c) research development environments (project) (Alyousef & Picard, 2011; Roussinos & Jimoyiannis, 2011), d) as collection and data management tools (Hoffmann, 2008), e) work presentation environments. Often, though, several of the above categories are combined (Roussinos & Jimoyiannis, 2013). According to Chu et al. (2011), students have a positive opinion for Wikis impact in the collaborative work and its quality.

Wiki's easy access, transparency and its unstructured pages help students share information and resources within their group, thus making it easier for them to work at their own pace and allowing them to see the work of other groups (Li et al., 2012; Woo, Chu & Li, 2013). Markopoulou and Tzimoyiannis (2014) research the impact of Wiki in Primary Education and they emphasize that Wikis exploitation in education is a teaching tool that enables students to change their attitude towards knowledge and from passive receivers become active participants in its construction (Markopoulou and Tzimoyannis, 2014). Siemens (2004) refers that a Wiki is an appropriate Web2.0 tool that supports teaching and learning and encourages group collaborative learning and knowledge construction through the continuous enrichment of the educational material, the use of educational techniques and activities based on *connectivism.* Researches claim that Wikis have a significant impact in students' collaboration and in the quality of their projects (Hughes & Narayan, 2009; Roussinos & Jimoyiannis, 2011).

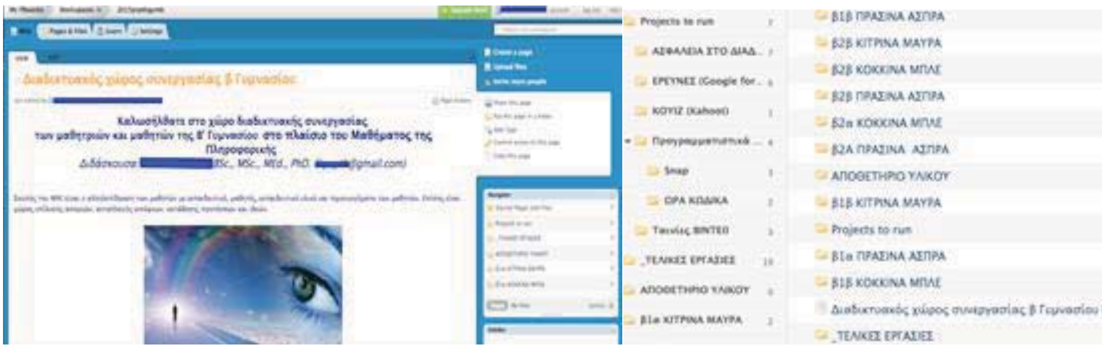
However some studies report that the use of Wikis has little impact on the interaction of students, which is mainly attributed to inadequate integration of Wiki support, in the teaching of a particular course (Cole, 2009).

This suggests that Wikis should be considered not only in terms of technological capabilities, but also in terms of educational and social factors that facilitate collaborative activity (Kirschner et al., 2004).

In Greece, since 2007 teachers are trained in ICT exploitation in the educational praxis. Since 2013 this training has been implemented to teachers of Informatics (http://b-epipedo2.cti.gr ). A part of the training context is the effective exploitation of Web 2.0 tools in teaching and learning. Here, teachers create, implement and evaluate, not only lesson plans but educational scenarios as well. Many of these scenarios use e-tools as blogs, Wikis, etc. which focus not only on technological skills development but also digital literacy. Through activities in the Wiki-class the students can synthesize and evaluate their own work and the work of others. The peer assessment improves their critical reflection skills and provides them with experiences which will help them to be able to evaluate easier, and make better amendments (Lai & Ng 2011). Also, interpersonal and communicative skills and mutual respect are encouraged via participants' interactions (Huang et al. 2010).

## 3. Wiki implementation in the class of ICT course

The Wikis exploitation can be achieved *in the classroom* and/or *outside* of it. This facilitates the educational process to be a more students – centered process. It is an e-tool that can be used as: a) announcements board, b) resource pool, c) communication channel between students, students-teachers and students - educational material d) forum for exchanging opinions and ideas and a place for solving queries, e) an e-space for organizing students' work, f) place for providing feedback on students assessments, g) monitor on students' work and their evaluation, i) place to co-plan and co-organize group e-meetings in the class and activities outside the class and j) e space for evaluating project meetings and activities (Figure 1).



a) b)

**Figure 1:** The ICT Course in Wiki (http://pbworks.com) a) the first page b) group folders and project folders

Concerning access, adjusting to a web-based class with a Wiki environment is an easy process for teachers and students as well. Teacher creates students' accounts either with their emails or without them, which is helpful since it overcomes the difficulty to create students' email accounts for those who either do not own one or for parents who do not allow one. All students have their personal account, the role of editor (i.e. they can read, write and edit in the Wiki) and are members of a group of four students. There are three large groups of 4-5 students and six small groups of 2-3 students which have a name inspired by De Bono's Six Thinking Hats (Table1) .

**Table 1:** Structure of groups in Wiki

| | | | |
|---|---|---|---|
| student1 | Small group1 (RED Hat) | LARGE GROUP A | CLASS B1 |
| student2 | | | |
| student3 | Small group2 (BLUE Hat) | | |
| student4 | | | |
| student5 | Small group3 (YELLOW Hat) | LARGE GROUP B | |
| student6 | | | |
| student7 | Small group4 (BLACK Hat) | | |
| student8 | | | |
| student9 | Small group5 (GREEN Hat) | LARGE GROUP C | |
| student10 | | | |
| student11 | Small group6 (WHITE Hat) | | |
| student12 | | | |

Students follow the «colour-properties» when they evaluate a project or a process or a suggestion (Figure 1b). Each student has its own subfolder where he/she can upload his/her files and assignments and contribute to the subgroup and group folders with classmates. Also, there are project-folders where all teams add their own work for it. The first Wiki page contains a welcome message and the most important reminders. All Wiki members can comment, suggest, express opinion (Figure 1a) and each new post is sent via email to all students.

For the current research three Wikis have been used, one Wiki per class which has two subclasses of 12 students each. Particular emphasis has been given to the Wikis' content which focuses on collaborative group activities that students upload , comment and present face-to-face in the classroom.

## 4. Research methodology

In the ICT course with Wiki exploitation 63 students, 13-15 years old, participate who have used Wiki for one, two or three years. There are 15 students of first grade of Lyceum School, 48 students of second and third grades of Gymnasium School. The research is both *quantitative* and *qualitative* and is implemented in the context of the ICT course in Experimental School of Aristotle University in Thessaloniki, Greece. The aim of implementing a quantitative and qualitative approach was to to triangulate the results of our research and to clarify questionnaires answers and/or collect information that had not been foreseen. In details we expected to balance the disadvantages and advantages of qualitative and quantitative approaches. Consequently, we have used a blended methodological framework by combining both methods. According to Cressweel (2008, p.554), the blended methodology combines the advantages of multiple data formats and the triangulation "continues to be an attractive approach for blended research methods today".

The *main aim of the research* is to investigate students' perceptions of the Wiki exploitation in ICT course. It is expected to change students' attitudes from 'pathetic listeners' to 'energetic participants'. The research questions are:

- Which is the *teacher's role and characteristics* in Wiki usage and which are the *students' preferences*?
- Which is the *Wiki impact* in the ICT course in students': a) performance b) interaction with educational material, classmates and teacher and c) creativity in and outside of the class?
- How can Wiki provide the educational material and implement appropriate *educational methodology* of the ICT course curriculum in order to manage and «catch» students' interest and active participation?
- What are the technological factors that support Wikis exploitation in Secondary Education and which are the prerequisites to implement it at school?

The methodological tools were *observation*, *semi-structured interview* and *questionnaires*. These tools were based on similar issues in order to achieve through *triangulation* validity and reliability of the research results (Cohen & Manion, 1994, p.123). The return rate of the questionnaires, which were delivered at the end of the school year, was that 1/3 of the students, and twelve (12) students were interviewed.

The questionnaire was designed such as to answer the research question. For this, it is based on *four issues* that form its *theoretical framework*. Each issue has achieved its aims with well-defined criteria, which form the *methodological framework* of the educational research (Vergidis et al., 1998, p.261-268). The four issues and their criteria are:

- *teacher 's role* with which we investigate the impact of teacher's instructions and the Wiki features that are preferable and/or appeared in the Wiki of the ICT course,
- *students' interaction,* which aims to investigate the duration and the frequency of students' interactivity in Wiki, their motivations to participate, the difficulties or limitations to be active users and the advantages and factors that lead to an effective exploitation of the Wiki in the educational praxis,
- *educational methodology* with which we investigate the students' attitudes and opinions about the aims clarity, the educational methods and techniques and the appropriateness of educational material,
- *technological environment,* with which we investigate *limitations and technical difficulties* that students face up and their opinions about the Wiki features according to their preferences and *expectations* for completing their assessments.

## 5. Results and discussion

The results of our research include: a) the teachers' role and characteristics, b) the reasons of students' participation in Wiki, their preferences, the factors that have affected the collaboration and/or their learning process and the role of discussions in forums and chats in large and in small groups, c) the educational methodology implemented in Wiki, d) technological issues concerning the easiness of navigation and collaboration in the Wiki environment.

### 5.1 Teacher's role

The teacher's role issue focuses on teachers' actions and attitudes using Wikis, according to students' opinions and expectations for using Wiki as an effective complementary educational tool.

As it concerns the teacher's help for effective Wiki usage, most of the students answered «very much» (68,4%) and «a lot» (21,1%) and just the 5,3% refer to «little» or «not at all». Students prefer a Wiki-teacher who is well-organised in the educational material, he/she explains the assignments with details in the Wiki environment (55,56%) and he/she encourages them with a friendly way to complete them (44,44% ). Also, students consider important the positive mood and collaboration between all Wiki members (33,3%). More than 1/3 of students (36,8%) have noticed their preferences to have a Wiki-teacher that takes care on students needs and difficulties and less than the 1/5 of them (16,67%) is interested in «rewarding» the creative students (Figure 2).

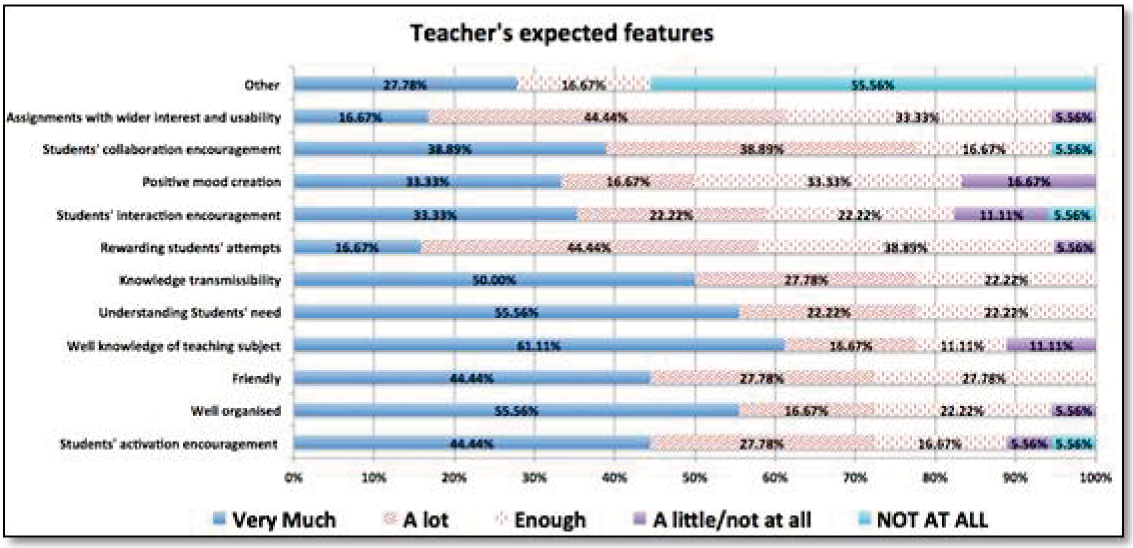



**Figure 2:** A Wiki-teacher according to students' expectations

The interview process clarified that younger students prefer gaming - activities with a competition and older students prefer gaming as well but with the possibility to create games. This result has led the teacher to change some activities of the current school year 2015-2016, assigning more game-based activities and letting students in groups to co-decide their way of learning. Future research is expected to discover the impact of it from the new evaluation of Wiki exploitation in the class. Afterwards, this will be compared with the result of the previous year in order to identify what assignments are interesting and attractive for students of 13 years old compared with those of 16 years old .

### 5.2 Students' interaction

This issue of students' interaction reveals their preferences and attitudes during the Wiki usage. Most of the students (47,4%) have participated for one school year in the Wiki of the ICT course, the 1/4 of them (26,3%) for three school years and the 21,1% for two. As it concerns the *frequency* of Wiki usage*,* most of them (66,7%) participated once per month and just the 16,7% more than once, although teacher was proposing to participate once per week. In the interviews process students explained that there was no need to participate more because they were informed on the Wiki updates due to emails sent and that they participated once per month mainly for uploading their project and/or evaluating others' work. But they have mentioned that in their answer once per month they have not encountered in their answers in questionnaire when they were following the discussions on various queries and they were participating manly one or two days before the class hour of the course. Thus, we can consider that their interaction was at least once per week and this needs more investigation to have a more precise conclusion about the frequency of Wiki usage. When students were asked to express what is the preferable frequency for them, 52.6% answered, "once per week,", 21,1% answered "every day," 15.8% answered 3-4 times per week, 10,5% answered "once per month," and none replied, "not at all.". In the interview process students explained that although the choice "once per week" was more preferable, many other school assignments limit them to participate more although they wanted it. They have also made two suggestions: a) the school should provide a Learning Management System as Moodle (www.moodle.org) and b) the teachers of the school should have a "picture" of what assignments are given and try to keep a "balance", in students' homework.

To investigate the *reasons that students interact in the Wiki*, they were asked to choose between four (4) reasons or to mention a different one. Students chose the *teachers' instruction* (78,9%) and mentioned other reasons, such as: the *use of educational material*, the *pre-saved in the Wiki assignments* and the *periodical communication* between teachers and students (Figure 3).

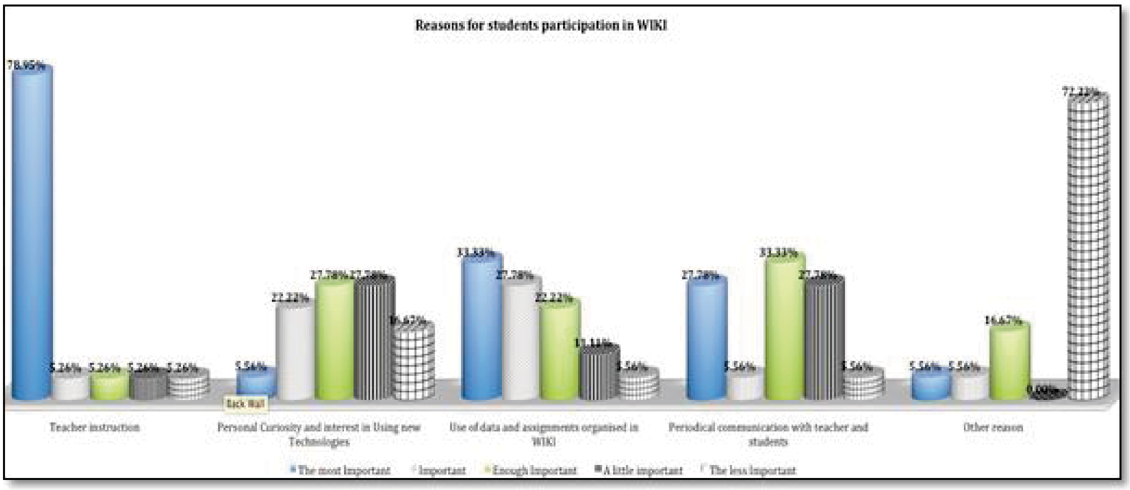



**Figure 3:** Reasons that students participate in Wiki

Regarding the *advantages of Wiki usage,* students consider the *educational material* and *assignments*, the *collaboration* and *exchanging material* with classmates and *the constant communication with Wiki members* (Figure 4).

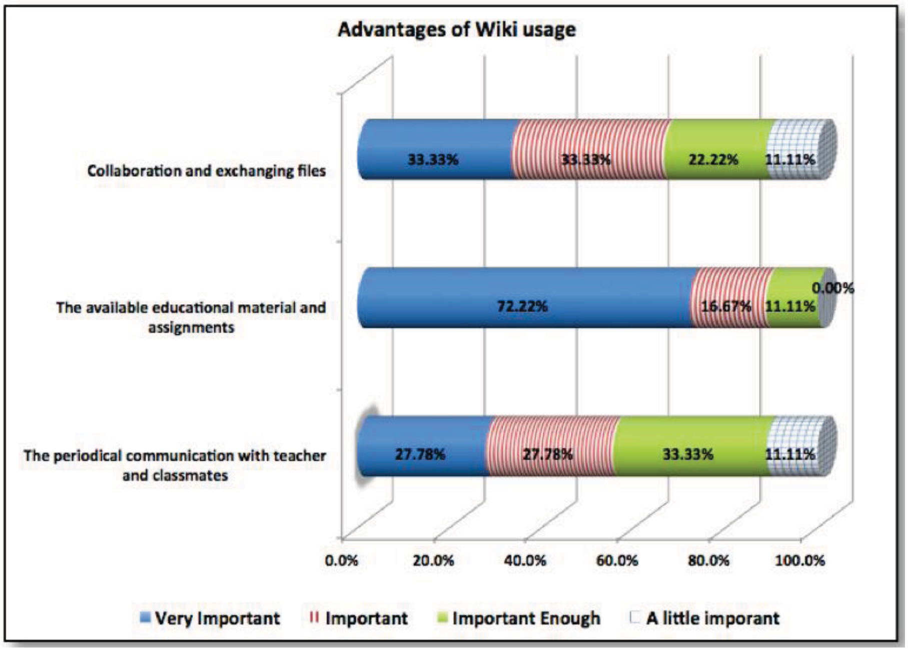



**Figure 4:** Students' rate the importance of Wiki advantages

## 5.3 Educational material and educational methodology

Moving on to the impact of the educational methodology in the Wiki, students have rated the easiness of: *a) communication for posting questions and difficulties, b) effective collaboration with classmates for completing group assignments, c) the possibility to continue team-working «outside» the school d) the clarity of activities aims and e) the time sufficiency to complete group assignments.*

The *aims* of the activities and the educational process have been mentioned as «well defined and clear» ("very much" 27,8%, a lot 33,3%, enough 16,7%m a little 22,2%, not at all 5,6%). During the interview process the younger students explained that they prefer to have more help on the way to complete their assignments. The more Wiki - experienced students although they were familiar with collaboration in it, preferred to have more resources to investigate. The *usability* of the educational material and the *sufficiency* of time to study it, was discussed. Although they think that the main advantage of the Wiki is the educational material available, 1/3 of the students characterized it as being a little use (very much 10,5%, a lot 31,6%, not at all 15,8%). This was explained in the interview process that they expect to have an alternative educational material with which they can interact (Figure 5).

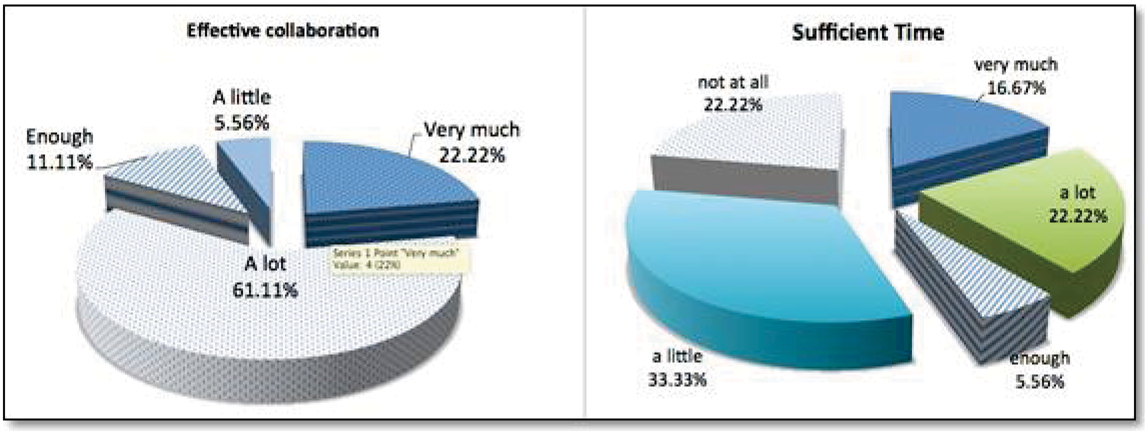



**Figure 5:** Wiki: Effective collaboration to complete assignments and time sufficiency to study

They also mentioned the lack of time to study the available material and complete their project-work and suggested to have assignments that combine other subjects as well to create collborative environment in the class and to have less number of activities for school. This has been taken into consideration for the current school year and teachers of various subjects assigned common project to groups of students.

Students emphasized the positive impact of the possibility to continue their assignments *outside the school* (very much 38,89%, a lot 16,67%, enough 22,22%, a little 16,67% and not at all 5,56%).

The above results have been taken into consideration for the following school year and it is expected to compare the results in future research plans.

## 5.4 Technological environment

Investigation of students' familiarization with ICT for educational purposes focused on their opinion for Wiki from a technological standpoint and was clarified by asking students about a) the frequency they use Internet connection to complete their school assignments, b) the factors that affect their active participation in the Wiki and c) the importance of learning via Wiki.

Results have shown that most of them use Internet, "every day," (61,1%) for educational purposes, 1/3 once or twice per week (33,3%) and none, "never," (or 3-4 times per year.) The internet connection is mainly at home (89%).

Most of the students believe that it is very important to have a well-organised Wiki with educational material, assignments, opportunities for communication with teacher and classmates outside the class. Students explained in the interviews that they do use Wiki more for posting queries on assignments and difficulties that they face up (Figure 6).

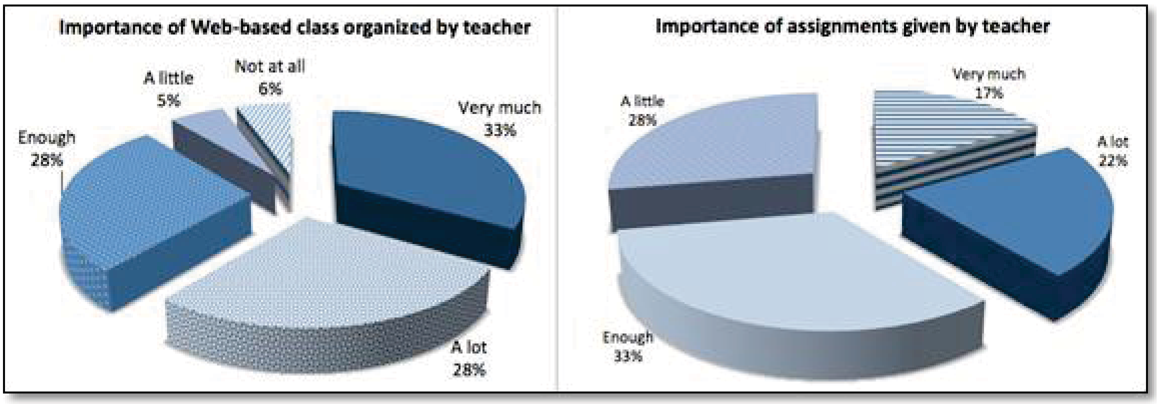



**Figure 6:** Important factors for using the Wiki-class

Wiki's impact on students' learning process is facilitated by the easiness of: a) assignments completion and submission, b) Wiki access, c) educational material availability, d) collaboration with classmates, e) communication with teachers (Table 2).

**Table 2:** Wiki elements that facilitate the learning process

| *Elements that help students' learning* | *Very much* | *A lot* | *Enough* | *A little* | *Not at all* |
|---|---|---|---|---|---|
| *Easiness to complete and submit assignments* | 52,6% | 21,1% | 21,1% | 5,3% | 0,0% |
| *Easy and quick use* | 47,4% | 5,3% | 36,8% | 10,5% | 0,0% |
| *Easiness to use the educational material in WIKI* | 36,8% | 36,8% | 26,3% | 0,0% | 0,0% |
| *Easy collaboration with classmates* | 31,6% | 36,8% | 21,1% | 10,5% | 0,0% |
| *Easy communication with teacher for solving queries* | 31,6% | 26,3% | 31,6% | 10,5% | |

These factors show the importance of assignment submission and as they said, «*although deadlines of assignments submission may stress students, it was very important that these deadlines were announced early and there were reminders in Wiki*» and «*the peer assessment gives responsibility to students for their learning and to classmates' learning as well*» .

## 6. Conclusions and future plans

We have presented an educational blended learning strategy in the Secondary Education ICT course, which can be used in other subjects as well. Wiki is a part of the ICT course curriculum in Secondary Education but it can be effectively used as a complementary teaching tool. Summing up the questionnaire results and comparing them with the students' interviews and teachers' observations we do confirm that Wikis exploitation in the educational praxis is a promising direction in students' learning.

The evaluation of the blended learning ICT course was achieved with the students' performance in completing assessments successfully, their progress in the Wiki environment, their answers in the evaluation questionnaire and the teacher's observation on students' active participation in the Wiki, per week.

The most important determining factor to use Wiki, seems to be the lack of time in a students' daily «overloaded program» and because of this they expect more guidance and activities assigned by teachers of different subjects . Smartphone ownership and the opportunity to use Wiki outside the class are considered important factors to actively participate in Wiki of the ICT course. As it was expected, students are familiar with new technologies and they can easily «pay attention» to the content of the ICT course through Wiki. They focus on the completion of their own teamwork assignments through collaboration and tailored support when it is necessary.

Students and teachers emphasize that there are not any difficulties or complexities on the Wiki technological environment and its tools. The goal of successful Wiki exploitation can be achieved with a teacher's thorough explanation, encouragement with a friendly way, taking care with a positive attitude and cooperation among all, especially for those with particular learning needs. Students recognize the easiness of completion and submission of their work through Wiki. The collaborative environment and the easiness to post and solve their queries when they need it, facilitate their learning process .The efficiency of their collaboration and interaction with the educational material, with the teachers and among each other, may create an effective learning environment. Students emphasize that the Wiki-teacher and his/her friendly motivation plays a significant role in their skill development for using Wiki in an effective and efficient manner. The exploitation of blended learning via Wiki in the ICT course starts with the fact that Wiki is attractive due to its easy access and the use of methodically saved course data, while communicating with classmates in their own environment. They certainly prefer their teacher to have an active presence in Wiki with suggestions, ideas, help with work, feedback and encouragement with collaboration. Students expect more personalized teaching, mainly for those who face up difficulties. They do not have a particular interest in personal reward and they expect to have a well organized teacher with deep knowledge of the subject. They prefer to have project-based assignments with wide interest and usability, and learn in a positive collaborative environment.

It is suggested to teachers to organize students in large and small groups and provide alternative educational material according to students' needs when it is necessary. Thus, Wiki can support differentiated teaching (Anderson, 2007). Results have shown that Wiki is an eminently collaborative online tool and student's cooperation is encouraged and are faced-up to cognitive difficulties in an easier way, co-create productive results and solve problems.

Wiki can support Secondary Education ICT courses. Thus, it not merely «acts» as a social phenomenon since it provides opportunities and possibilities for student's comments, feedback, evaluation, discussion and posting of their reflection of learning. Some of the Wiki's advantages are: *flexibility* and easy access, the *transparency* comparing with other technological environments, the possibility of *commenting* and *evaluating* various projects and assessments that have been submitted in the Wiki environment, the free of cost use and the no need of teachers training. These advantages help students to complete their assessments without the need to meet classmates face-to-face and to solve queries by direct post in the Wiki class. Wiki's exploitation may be innovative since various teaching methods and techniques can be implemented and provide effective learning. Of course it depends on teachers' background and their studies on pedagogical issues, their teaching experience and their behavior as facilitators and coordinators of the educational process. Students expect to gain scientific knowledge via the technological environment in which they experience «learning by doing» in a students-centered educational process and not just with «knowledge transmission»..

In our future research work we plan to continue our research in blended learning strategy with Wiki exploitation both in ICT course and in other subjects as well. Also, the use of other e-tools (as Learning Management Systems) is expected to give more support in engaging students in educational process and provide them multiple learning opportunites.

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# School Teacher Professional Development in Online Communities of Practice: A Systematic Literature Review

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**Abstract:** This study informs researchers of educational technology, teachers, teacher associations and moderators or admins of online platforms who are interested in knowledge sharing among teachers within online communities of practice (CoPs). The continuous professional development of teachers is primarily about improving their teaching practice. It includes both formal and informal learning activities to transform attitudes, behaviour, skills and knowledge. Formal knowledge sharing methods like training workshops have failed to deliver the desired on-demand, context-appropriate knowledge. On the other hand, informal knowledge sharing through CoPs can transform teachers by contributing to their immediate context or needs. There are various national and global IT platforms that are designed to enable teachers to participate and share knowledge in a CoP but in many countries, online platforms for the professional development of teachers are relatively new. This systematic literature review reports a qualitative synthesis of literature on in-service teachers' online CoP participation. It adheres to the five-step literature search and analysis process by Creswell (2012). Seven peer-reviewed articles were included from 603 initial records. Applying an approach inspired by grounded theory (Corbin & Strauss, 1990), themes were identified in each article and then grouped into seven categories as follows: (1) In the online communities of practice, in which activities do teachers engage with one another? (2) What knowledge do teachers share in the online CoP? (3) What motivates teachers to participate and share knowledge in the online CoPs? (4) What are the barriers to teachers' participation and knowledge sharing in the online CoP? (5) What roles do moderators play in teachers' online platforms? (6) What are the perceived benefits of teachers' online CoPs? (7) Which factors should be considered while developing online platforms for teachers?

**Keywords**: school teacher, professional development, communities of practice, teacher knowledge sharing, teachers' emotional development, barriers to online participation

## 1. Introduction

Web based platforms, particularly those designed and developed for school teachers, facilitate access to authentic materials and experiences, eliminate physical boundaries and pose no time restrictions. The innovation of such online communities of practice (CoPs) enables people "not just to do more of the same, but to do something different, something powerful, something appropriate for all learners in the new millennium" (Riel & Fulton, 2001:523). The framework for 21$^{st}$ Century learning, which re-envision students' learning in the rapidly evolving technological world, includes four broad skills categories: (1) core subjects (e.g., English, mathematics and science) and 21$^{st}$ Century themes; (2) life and career skills; (3) learning and innovation skills; and (4) information, media, and technology skills (Bellanca & Brandt, 2010). "The framework recognizes that educational support systems – especially professional learning experiences – are vital" (Bellanca & Brandt, 2010). Despite teachers' time limitations, anecdotal evidence suggests that online platforms can contribute to the development of professional learning experiences (Baek & Barab, 2005). Online platforms that cover one or more of the 21$^{st}$ Century learning categories are rapidly growing and contribute to teachers' knowledge sharing. However, scientifically, the realization of teachers' online CoPs within or beyond national boundaries is an understudied area. Although online initiatives for professional development on an individual level or at school level started some time ago, the same for school teachers is a new phenomenon in many countries' national strategies. Therefore, the purpose of this literature review is to summarise the findings on in-service teachers' professional development and the role of online platforms designed for or adopted by school teachers towards forming a community of practice.

The objective is to use a number of research questions to identify and categorize the themes that would contribute to designing online platforms for school teachers' professional competence development, and the formation of CoPs. The review does not intend to answer a specific question but rather identify the scope for further research.

The paper is structured as follows: First, it presents the key terms related to online CoPs to reflect on the philosophical assumptions and practical premises. Second, the methods applied for literature selection and analysis are briefly reported. Third, a summary of the reviewed papers followed by a synthesis of articles is reported by categorizing them in the form of questions.

## 2. Communities of practice

From a socio-cultural and historical perspective, Lave and Wenger (1991:98) defines a CoP as follows:

> *"A community of practice is a set of relations among persons, activity, and world, over time and in relation with other tangential and overlapping communities of practice. [It] is an intrinsic condition for the existence of knowledge, not least because it provides the interpretive support necessary for making sense of its heritage. Thus, participation in the cultural practice in which any knowledge exists is an epistemological principle of learning."*

Wenger's *architecture of learning* includes four spaces or dimensions: participation and reification, the emergent and the designed, the local and the global, and identification and negotiability (Wenger, 1998). *Participation* is "the social experience of living in the world in terms of membership in social communities and active involvement in social enterprise" (Wenger, 1998:55). Reification is "the process of communities and active involvement in social enterprise". These two processes are complementary. The *designed* and the *emergent* dimensions are related to time; the designed activities for teaching and emergent learning activities are not the same. *The local* and the *global* emphasize the context sensitivity and generalizability; this focuses on the challenge of sharing local experiences in a way that will be useful and relevant for other contexts. The emphasis of *identification* and *negotiability* is on resolving conflicts and "how the power to define, adapt, or interpret the design is distributed" (Wenger, 1998:235).

Communities develop their practice through a range of activities like problem-solving, requests for information, reusing assets, coordination and synergy, building on argument, growing confidence, discussing developments, documenting projects, visits, and mapping knowledge and identifying gaps (Wenger-Trayner & Wenger-Trayner, 2015). In keeping with different activities, CoPs are also known by other names such as thematic groups, learning networks and tech clubs.

McClure, Wasco and Farad (2000) examined three CoPs to see why people participate and share knowledge online. They applied three perspectives of knowledge: knowledge as an object (justified true belief), knowledge as embedded in people (that which is known) and knowledge embedded in the community (the social practice of knowing). The value of content were categorized into *tangible returns* (useful, valuable information, answer to a specific question and personal gain), *intangible returns* (enjoyment/entertaining, learning, interaction with a community, multiple viewpoints, peer group, altruism/pro-social behaviour, reciprocity or give something back to community in return, advance the community) and *barriers to participation* (group related barriers caused by undesired responses and obstacles to participate). While these findings might persuade school teachers to take part in an online CoP, the teachers would also like to know what to expect from a CoP and how to achieve their desired personal and community goals.

## 3. Method

This systematic review of literature is conducted adhering to Creswell's five-step literature search and analysis process (Creswell, 2012:81).

- Identify key terms to use in your search for literature
- Locate literature about a topic by consulting several types of materials and databases including those available at an academic library and on the Internet
- Critically evaluate and select the literature for your review
- Organize the literature you have selected by abstracting or taking notes on the literature and developing a visual diagram of it
- Write a literature review that reports summaries of the literature for inclusion in your research report.

### 3.1 Identify key terms

Three searches were conducted using the keywords "teachers learning", "development", "online" and "communities of practice". The keyword "teacher education" was discarded – the objective is to review in-service teachers' practices and not how teachers are educated.

## 3.2 Locate the literature

The systematic literature search was conducted using Google Scholar through Publish or Perish software (Harzing, 2012), and library-facilitated access to databases. The searches were restricted to English, peer-reviewed, full-text accessible resources, and from 2000 to present.

## 3.3 Critically evaluate and select literature

Figure 1 illustrates the method of search, examination and assessment of suitability or exclusion which is based on the PRISMA flow diagram (Liberati et al., 2009). First, 580 articles were identified through Publish or Perish software (Harzing, 2012). The program sorted the articles by relevance and the first 100 articles were screened considering their title, abstract and keywords. In the process, 94 of the 100 were excluded and 6 articles were selected. The reasons for excluding some articles were one or more of the following: (1) The text's focus is different from (elementary/primary/secondary) school teachers' learning, (2) the central issues do not involve online platform and teachers' practice or participation, or (3) the text has another focus.

A second search was conducted on Proquest, using different combinations of the keywords "teachers", "learning", "development" and "virtual communities of practice". This search returned 14 articles, 10 of which were screened. Finally, a backward-chaining exercise identified nine more articles. The literature selection process ended with 25 articles that were either journal papers or conference articles.

In the assessment phase, the 25 full texts were evaluated for their suitability and 18 were excluded, leaving seven articles for systematic analysis and synthesis.

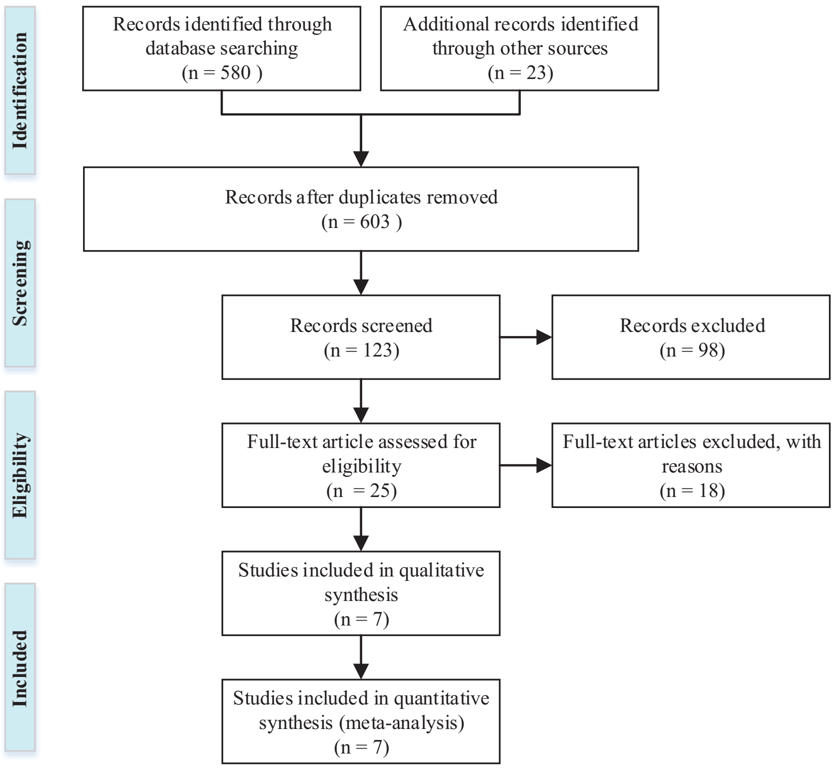


**Figure 1:** PRISMA flow diagram (Liberati et al., 2009)

## 3.4 Organize the literature and visualize it

In the results and discussion section, the seven articles are summarized by noting the research problem, the research question, the data collection procedure and the findings, as suggested by Creswell (2012).

The process of analysis and synthesis followed an approach inspired by grounded theory (Corbin & Strauss, 1990). The identified themes were grouped into broader themes. When new themes were identified, they were added to the list, and when a theme matched an existing theme, the article was marked against that theme on the list (Creswell, 2012). The visualization in Table 1 helps to see overlap amongst the findings in the articles (Creswell, 2012) but the visualization of inter-theme relationships is not shown in this paper.

## 4. Results and discussion

This synthesis includes six journal papers and one conference article, all of which were published during 2005-2014. Table 1 shows an overview of the themes, authors and the country of the institution they are affiliated with, and the year of publication.

*Baek and Barab* (2005) write, "In order to illuminate potential difficulties which may arise when attempting to design a framework to characterize or to build a CoP, this study describes the dynamics of five dualities (specific areas of tension) that were identified during the design and testing period of […] a Web-based community for teachers' professional development" (p. 161). Their data includes document analyses, interviews with designers, researchers and teachers, and observations of online and face-to-face meetings. Their research question is: What aspects of the design were gradually changed? How, why and when were they changed from the initial design? (p. 162).

*Chen, Chen & Tsai* (2009) examine six synchronous online discussions among the teachers on a course for teachers' professional development. They look at 3600 messages and interview 10 teachers. The research questions are designed to (1) examine the benefits and frequency of synchronous discussions from interaction types, cognitive and metacognitive skills, and (2) learn how messages vary by time of posting and the participating teachers' perceptions towards the synchronous discussions of online teachers' professional development.

*Duncan-Howell* (2010) examines three different online communities in Australia based on a quantitative online survey with 96 participants (from a local state-based community, a national online community and an international one). The research question explores the online communities' nature and Duncan-Howell offers some conclusions about their potential and resources for professional learning for teachers (p. 327).

*Gaillard & Rajić* (2014) present "a case study of a successful community of practice developed under the umbrella of Council of Europe Pestalozzi program for teacher development" (p. 457). The platform contains different rooms, a reception area, a coffee shop, and professional development and exchange spaces. They report the pros and cons of the virtual CoP.

*Hew and Hara* (2007) observe activity and messages on a national online platform for language teachers in the United States. They examine a large mailing list. The research question is: What activities and knowledge do teachers share with each other, and what are their motivators and barriers to sharing knowledge?

*Hur and Brush* (2009) examine online communities established by teachers themselves. They interview 23 teachers who participate in the independent online communities and analyse 2000 posts. They develop a case study based on eight criteria. Their research question is (p. 283): "Why do teachers want to participate in self-generated online communities of teachers?"

*Vavasseur and McGregor* (2008): "This mixed method case study provides insights about how the professional development of middle school teachers is facilitated through their participation in content-focused online CoP. A key finding from this research reveals that the online community provided teachers with enhanced opportunities to share ideas, to discuss issues, and to make new connections with colleagues as well as with their principal" (p. 517). Their research questions are (p. 517): What was the focus of the interactions among teachers while they participated in the online community of practice? How did teachers perceive the participation of their school leaders in the online community?

### 4.1 What knowledge do teachers share in the online CoP?

The articles identified and suggested various approaches on how to initiate and increase participation in an online platform for professionals.

**Table 1:** Overview of the reviewed articles and identified themes

| **Year of publication** | **2005** | **2007** | **2008** | **2010** | **2014** | **2014** | **2014** |
|---|---|---|---|---|---|---|---|
| Author(s) | Baek & Barab | Hew & Hara | Chen, Chen & Tsai | Duncan-Howell | Vavasseur & MacGregor | Hur & Brush | Gaillard & Rajić. |
| Background | | | | | | | |
| Geographical distribution | USA | USA/ Singapore | Taiwan | Australia | USA | USA | Croatia |
| **Article type: conference paper (C) / journal article (J)** | **J** | **J** | **J** | **J** | **J** | **J** | **C** |
| **Themes:** | | | | | | | |
| The teachers' basic need: more time | X | X | X | X | | | |
| Technical complexity, technical insecurity | X | X | | | X | | |
| Who is participating in the platform? Is the communication private or public? | X | | | | X | | X |
| The purpose of the community: Fulfil school reforms or daily practice? | X | | | X | | | |
| Internet access | | | X | | | | |
| Need for new competencies and a language | X | | X | | | | |
| Moderator or facilitator is essential for development | | X | X | | X | | X |
| Monitoring and reflexivity over the learning process | | X | X | X | X | | X |
| Consideration for the design of the platform | X | X | X | | | X | X |
| Motivators and barriers for digital communities of practice | | X | | X | | | X |
| Teachers get new/updated subject knowledge | | X | | X | X | | |
| Reasons for the teachers´ participation or lack of participation | | | | X | | X | X |
| What influence does it have on teachers when they participate in a digital community of practice | | | | X | X | X | |
| Online discussions´ content | | X | | | X | X | |
| Anonymous participation | | X | | | | X | |

Most of the articles reported that teachers exchange professional knowledge, materials and teaching strategies in the online CoP. Teachers also share feelings and concerns about their profession (Hur & Brush, 2009; Vavasseur & Kim MacGregor, 2008)

Hew and Hara (2007) found that teachers share book knowledge, practical knowledge and cultural knowledge. The most common types of knowledge shared were opinions, personal suggestions, book knowledge and institutional practice. Practical knowledge, which refers to knowledge related to actual practice, were further classified into one of the following three main categories: (a) personal opinion, (b) personal suggestion and (c) institutional practice. Personal opinion refers to an individual opinion not necessarily representing best practice.

Duncan-Howell (2010:338) recognised that online communities proffer forums where teachers can discuss strategy changes, gather evidence and make proposals for new strategies. Hur and Brush (2009:291) found that, apart from knowledge sharing, feelings are also shared and this attracted the most attention.

Vavasseur and McGregor (2008) found that online discussions contain not only professional and resource issues, but are also about the development of new materials, identifying problems and professional discussions about students' use of computer technology. The teachers and principals participated in a content-focused community and posted on "teachers' perceptions of their personal computing efficacy, content-focused dialogue, and concerns about students' use and misuse of technology" (p. 527).

### 4.2 In the online CoP, with which activities do teachers engage with one another?

All the studies that analysed online content dealt with discussion forum posts. Out of their analysis of 630 online messages, Hew & Hara (2007) found 9 types of activities that teachers share with each other: requests, appreciation, official comments, announcements, apologies, clarification, compliments, empathy and knowledge sharing.

Chen et al. (2009:1158) applied an analysis framework to categorize messages in four major dimensions: "*participation rate*, *social cues* [i.e. a statement which is not related to formal content or subject matter], *interaction types* [i.e. direct response, indirect response, independent statement, other*], cognitive and metacognitive skills.*" Cognitive skills are categorized and defined as *elementary clarification*, *in-depth clarification*, *inference*, *judgment* and *strategies*. Metacognitive skills are categorized as *evaluating*, *planning*, *self-awareness* and *none*.

### 4.3 Which factors should be considered while developing online platforms for teachers?

The articles reported five factors to the developers of online platforms: (1) the teachers' influence, (2) technology complexity, (3) communication opportunities, (4) the purpose of the platform and (5) the participants' different roles in communication.

First, the importance of the teachers' influences on the design. Is it designed for teachers? Can the teachers influence the design and thereby experience ownership? Baek and Barab (2005) pointed out that teachers want designers who understand their culture. "To ensure that participants successfully engage in the learning process, the content must address the needs of the teachers" (Duncan-Howell, 2010:337). Similarly, Duncan-Howell (2010) pointed out: "For professional learning to be sustained and not limited to short programs, the mode of delivery needs to suit teacher conditions and be sympathetic to their specific needs as learners"(Duncan-Howell, 2010:325).

Second, the complexity of the platform. The researchers are not in agreement whether complexity promotes or discourages participation. Baek and Barab (2005:171) discovered that technical complexity could provide a sense of community among the participating teachers since they work together to solve problems. On the other hand, Baek, in Hur & Brush (2009:282), saw that a lack of technical support inhibits participation. Chen, Chen and Tsai's results suggested that there must be space for the teachers in the daily schedule to include online professional development. The teachers' technological expertise and knowledge of online learning platforms differ and access to the Internet and computers in the workplace have an impact on their online learning experience (Chen et al., 2009:1156, 1163).

Third, is it a public or a private network? Is there an opportunity for both?

> *New social contingencies are required, in which participants are willing to engage in critical dialogue about teaching practices […] The addition of a private place where small groups could work together called for fundamental changes in the underlying assumptions of the ILF [Inquiry Learning Forum ] design (Baek & Barab, 2005:172).*

Gaillard and Rajić (2014) agreed that private versus public network access should be taken into consideration; The European network they studied only accommodates projects and suggested a design with spaces for professionals across projects.

Fourth, the developer must consider the purpose. Hur & Brush (2009) found that the developers of online communities need to be more aware of the teachers' emotional sharing and the need to promote professional self-confidence. "To create a Web-supported community as a vehicle for education reform is not to build a single technical tool, but rather to create a socio-technical network" (Baek & Barab, 2005:176). Is the network a platform for the introduction of a school reform? Who participates in the network – only teachers or is it opened for the principal and others? What internal and external borders does the community have? (Baek & Barab, 2005:174).

Finally, the platform should provide scope for users to have different participatory roles. Many teachers might want to participate anonymously so that they can share problems that they cannot discuss at their local school (Hew & Hara, 2007). Some argue that anonymity help them to contemplate the situation objectively (Hur &

Brush, 2009). Lurkers are also named as participants in online communities; lurkers are people who read posts but don´t write posts themselves (Hur & Brush, 2009).

In summary, developers must be aware of teacher culture and context, the purpose of the platform, the complexity of the technology and that teachers have different abilities and needs. Developers must understand the community's target users (and their variations) and allow the opportunity to share emotional experiences. The CoP must provide space for different participatory roles such as anonymous users and lurkers. "However technically well-designed, a network does not necessary guarantee active participation" (Baek & Barab, 2005:172). It is important to design networks in such a way that a prospective and desired participant is not prevented or discouraged.

### 4.4 What motivates teachers to participate and share knowledge in the online CoP?

Teachers participate in CoPs because of their professional needs and for emotional support (Duncan-Howell, 2010). They also participate when the discussions focus on classroom strategies or themes relevant to them. Teachers' average online community participation is approximately 1.5 hours a week, translating to 60-80 hours a year (Duncan-Howell, 2010:338). Hur & Brush (2009) found five reasons why teachers participate: to share feelings about teaching, to find opportunities in online environments, to combat isolation, to explore ideas and to experience companionship. They referred to Vasconcelos who concludes that "the most crucial aspect of an online community is not the information shared in the communities, but rather the sense of belonging that participation engenders" (Vasconcelos in Hur & Brush, 2009:291–299).

Seven motivators to share knowledge were found: collectivism, positive feedback, personal gain, altruism, technology, a respectful environment and interest from other teachers (Hew & Hara, 2007:583–586). The ideal seems to be a culture borne of collectivism and positive feedback, requiring both professional discussions and emotional support, and supporting the need to belong while avoiding isolation.

### 4.5 What are the barriers to teachers' participation and knowledge sharing in the online CoP?

Hew & Hara (2007) found five barriers to participation and knowledge sharing: lack of knowledge, lack of time (or competing priorities), uncertainty in the application of the technology, not wanting to cause a controversy and a negative attitude towards the information seeker (including egocentric attempts to reserve knowledge).

Chen et al. (2009) identified barriers to be teachers' lack of technical computer expertise, their unfamiliarity with online communities and limited access to computer and Internet resources and services (i.e. restricted to working hours in the workplace).

Vavasseur and McGregor (2008) discovered that unresolved or high expectations from principals could hinder teachers from actively engaging in learning communities. Baek & Barab (2005) reported that several teachers were unable to express themselves or perform well online as they were afraid of being criticized by colleagues; their only online comments were superficial.

Gaillard and Rajić (2014) concluded that further research is needed to understand why some teachers participate and others do not. It would be interesting to gain insight into the characteristics that push practitioners towards a more reflective practice.

To summarize, the barriers perceived by teachers are time, technology, access, lack of knowledge and emotional barriers such as fear of criticism, negative attitude, the principals' involvement and a lack of language skills.

### 4.6 What roles do the moderators play in teachers' online platforms?

A moderator is a steward in an online community of practice; the role establishes a human presence to coordinate the CoP fellowship, lead meaningful and goal-orientated dialogues and help members develop (Gaillard & Rajić, 2014). Vavasseur and McGregor (2008) found that thought-provoking questions from the facilitator who supported the discussions, garner more participation and that the availability of technical help is a key to success. The moderator significantly contributes to solving or circumventing technology barriers and avoiding misunderstandings that arise through the lack of body language and tone (Hew & Hara, 2007).

A moderator’s participation and other roles is essential to the participants' learning (Chen et al., 2009). When a moderator qualifies the discussion, the participants get involved and contribute with cognitive and metacognitive reflections. The learning outcome is increased if the teachers are monitoring and regulating their students’ knowledge and learning process during the discussion (Chen et al., 2009). Reflexivity, understood as committed reflexive conversations between participants, is the reason why online communities succeed and give control to the individual teacher. Committed, detailed questions increase motivation and receive positive responses. However, when a principal initiates discussions, the participants feel that he or she is breathing over their shoulders or inspecting them (Vavasseur & Kim MacGregor, 2008).

Pedagogy, the knowledge and practice of teaching, is improved by a process of critical reflection in a community of educators (Kemmis, 1989 in Duncan-Howell, 2010:326). In addition to monitoring the discussions, teachers must develop a new competence: increased learning through online discussions. This happens by focusing on the topic, engaging participants in deep learning, engaging in meaningful discourse and by involving cognitive and metacognitive skills (Chen et al., 2009).

### 4.7 What are the perceived benefits of teachers’ online CoPs?

Digital platforms help develop teachers to become more reflexive and mature their competence as technology providers or facilitators. The interviews by Hew and Hara (2007) suggested that online knowledge sharing help teachers to achieve new insights and ideas regarding the subject material and remain up to date in their subject area. Gaillard & Rajić (2014) also found that learning takes place in the CoP when teachers share their experience and offer informed opinions. Duncan-Howell (2010) found that the network offers the opportunity to be introduced to new ideas and to teaching methods improved by a process of critical reflection in a community of educators. The varieties of professional learning opportunities offer meaningful professional development. Hur and Brush (2009) explained how sharing ideas and tips with other teachers online can assist teachers not only with new ideas but also to reflect on their teaching strategies. Vavasseur & Kim MacGregor (2008) showed that teachers use humour among themselves in their learning process and that they value the use of a computer to grow their teaching practice. They receive curriculum-based knowledge, increase confidence in implementing technology and participate in the development of internal academic subjects.

In summary, the studies indicate that online communities of practice increase the teachers’ professionalism, augment their experience and update their subject knowledge through discussions and affiliations in an online community of practice. Teachers achieve a reflexive level that strengthens their self-confidence and teaching practice as technology facilitators.

## 5. Conclusion

The seven articles reviewed show that there is great variation in the design, structure and use of virtual communities. However, this review is concerned with the online community’s role in teacher practice development and what effect the platforms’ design may have.

Online CoPs include opportunities for professional discussions and sharing of professional resources, materials and teaching strategies. Additionally, teachers discuss didactics, pedagogical issues and changes. Hew and Hara (2007) found that knowledge sharing and emotional sharing takes place among teachers. A future study might investigate how the construction of the platform supports both knowledge and emotional sharing; especially, does the design impact on what is shared?

The investigations highlighted a number of areas that designers should consider to ensure that the design and development of the online platform do not pose barriers to teachers. The articles concluded that developers should:

- Know the teachers´ culture and context
- Know the community/network's purpose
- Consider the complexity of the platform - teachers come with different needs and requirements
- Know the purpose of the platform
- Give the opportunity to share emotional experiences

- Allow different roles and visibility levels such as anonymous responders and lurkers.

It is evident that there are motivating factors for as well as barriers to teachers' participation and knowledge sharing in online CoPs. It appears that a culture of collectivism and positive feedback predominates among teachers when it comes to the exchange of knowledge and professional resources. They seek out professional didactic coaching and value emotional support; the online community offers a sense of belonging and helps teachers avoid professional isolation. On the contrary, teachers' professional workday schedules are perceived as a barrier, along with a lack of technological skills and lack of knowledge. This perceived barrier discourages teachers from participating. Finally, there may be an emotional barrier that causes teachers to avoid participation or to participate only superficially. This emotional barrier is triggered by a fear of criticism, leaders or facilitators who want to control dialogue rather than lead it, or a lack of linguistic skills to give and receive constructive criticism.

The literature suggested two main factors that are essential for professional development and positive learning outcomes through online communities: a suitable facilitator/moderator and a good structure for communication. First, a good facilitator is essential to moderate the framing and qualifying process of an online discussion, to lead teachers to the desired reflexive level and to help them benefit optimally from their participation. Topics for future study could include (1) What moderator questions would create a "good" online CoP for teachers? and (2) What qualifies a person as a moderator compared to other participants? These questions are not addressed in the reviewed articles. The second essential factor for any CoP is how its structure enables convenient communication; the premise is that all participants must have a common interest in the theme (Wegner, 2002 in Hew & Hara, 2007:575).

Online CoPs offer various opportunities but they also necessitate the development of new skills (i.e. IT skills and other), to manage various threads and participate in the different roles. This could also be a future research topic: How can teachers learn about the different online participation and facilitation categories and the required skills for these?

None of the reviewed articles investigated different school cultures as an element that might impede teachers' participation in global online communities. However, inter-cultural exchange through online CoPs has been discussed in existing literature.

Last, the literature suggested that national and international online CoPs for teachers can build competence and contribute to educational development locally, nationally and globally, depending on the scope, language, content, access and other factors of the platform.

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# The Role of Perceived Relevance and Attention in Teachers' Intention to use Gamification

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**Abstract**: Gamification is becoming a trending topic in education as a new teaching methodology to increase attention and to engage students in their learning process. Despite the increasing academic interest in gamification little research has been devoted to analyze teacher's beliefs regarding the use of gamification in their courses and how these beliefs affect their attitude intention to use gamification. Using Keller's ARCS model as a theoretical framework the role of perceived relevance and attention in teachers' attitude and intention to use gamification is analyzed. To do so a research model is tested using a sample of 312 higher education institutions teachers via structural equation modeling to predict teachers' attitude and behavioral intention to use gamification in their courses. Results suggest that perceived attention drawn by gamified classes is a factor affecting teachers' intentions to use gamification in their courses. Perceived relevance was not found to affect directly attitude while teachers' perceived attention was found to affect teachers' perceived relevance of gamification. Limitations of the study and future research lines are also addressed.

**Keywords**: gamification, higher education, relevance, attention, attitude, intention to use

## 1. Introduction

Gamification is attracting an increasing attention among both academics and practitioners. The use of serious games, educational video games, serious toys, augmented reality games, and alternate reality games has important implications in areas such as business, healthcare, education or entertainment in a context that has been described as the *ludification of culture* (Deterding et al 2011). Education is one of such areas in which the interest for gamification is gaining momentum. In fact, papers on gamification published in top academic journals has increased times five over the last five years (Martí et al 2015). Extant research on gamification has covered a wide range of topics and areas including energy education (Yang, Chien and Liu 2012), veterinary education (De Bie and Lipman 2012), citizenship education (Lim and Ong 2012) or nanotechnology education (Blonder and Sakhnini 2012). Among the reasons that have been pointed out for the use of games or games elements/mechanics in education is that classroom gamification may be appealing and motivating for the new generations of students that have grown up in the age of video games (Glover 2013). It is assumed that the elements that make games fun along with the nature of games themselves are intrinsically motivating (Adams et al. 2012) so applying game mechanics to the classroom may increase students' intrinsic motivation to learn (Hanus and Fox 2015). The use of games or games elements can also improve students' engagement and learning outcomes (Clark et al. 2011) and can be used to tailor difficulty progression that facilitates scaffolded instruction based on each individual student's needs (Hanus and Fox 2015). Games also offer a visual display of progress – e.g. badges– (Kapp 2012) and give students the freedom to fail without fear when learning (Lee & Hamer 2011). Trial-and-error process which makes mistakes recoverable can also be favoured by games (Hanus and Fox 2015). Although most of previous research has focused in analysing the effectiveness of gamification and based-game learning (for a meta-analytic review see: Sitzmann 2011) there are few studies that have explored the drivers of teachers' behavioral intention to use gamification in their courses. As teachers are key agents in the teaching-learning process (Biesta, Priestley and Robinson 2015) and teachers play a key role in introducing pedagogical innovations in the classroom –especially technology-related innovations (Ketelhut and Schifter 2011; Mumtaz 2000)– teachers' drivers to adopt gamification will play a key role in implementing or not gamification in their courses. Therefore, this study is focused on two potential drivers (teachers' beliefs about the capacity of gamification to draw students' attention to the learning materials and teachers' perceived relevance of gamification to deliver learning content). This paper structures as follows: firstly, we review Keller's ARCS model (1987) focusing on attention and relevance to posit our hypotheses. Secondly, we present the method used and the results. Finally, we address discussion, conclusions, limitations of the study and future research lines.

## 2. Keller's ARCS model

Keller's ARCS model (1987) is one of the most widely mentioned theories of motivation and it has been suggested that Keller's ARCS model should become the standard by which the game increases learning motivation (Karoulis and Demetriadis 2005). In fact the ARCS model has been widely used to evaluate and design instructional programs' motivational stimuli (House 2003; Chang and Lehman 2002; Song and Keller 2001; Wongwiwatthananukit and Popovick 2000) and has also been tested in computer-based learning (Huang, Huang, Diefes-Dux and Imbrie 2006) and gamification contexts (Su and Cheng 2015; Dempsey and Johnson 1998; Klein 1992). It is widely accepted that the ARCS model is suitable to investigate motivational issues in gamification contexts (Astleitner and Wiesner 2004). As all motivation theories, Keller's ARCS model assumes that individuals are motivated to the extent that their behaviour is expected to lead to desired outcomes (Robbins 2005). The expected outcome is derived from the expectancy-value theory (Tolman 1932; Lewin 1935) which assumes that people are motivated to engage in an activity "if it is perceived to be linked to the satisfaction of personal needs (the value aspect), and if there is a positive expectancy for success (the expectancy aspect)" (Keller 1987, p.3). Human behavior is then "a compound function of perceived probability for success (expectancy) and perceived impact of the success (value)" (Huang, Huang and Tschopp 2010). Motivation is therefore a result of an interaction between a situation and an individual and "it is premised on an individual's desire for change, which is situationally driven" (Su and Cheng 2105, p. 271). Keller's ARCS model uses a multidimensional approach to measure the motivational drivers of individuals focusing on: i) attention, ii) relevance, iii) confidence (control), and iv) satisfaction. Relevance of teaching materials and the capacity of teaching materials to draw students' attention are considered key factor in this learning process.

*Relevance and attitude*

Relevance indicates both the process and the value of the learning content to the learner (Keller 1987). Relevance does not have to come just from the content itself but also from the way something is taught (Keller 1987). We conceptualize relevance as teachers' beliefs that gamification will provide learning value to students and that value comes both from materials used and the way the learning content is taught (gamification approach). The relationship between perceived value (relevance) and attitude has a long tradition in the expectancy-value theory (Tolman 1932; Lewin 1935). Therefore we posit the following hypothesis:

> *H1: teachers' perceived relevance of gamification will affect teachers' attitude towards gamification.*

*Attention and attitude*

Keller's (1987) ARCS model assumes that media can moderate learners' attention and curiosity, this is, different media can increase attention and curiosity in different degree. Drawing attention to the learning materials (e.g. novelty in innovative learning materials such as gamified activities) might therefore increase students' motivation to learn. From a teachers-focused approach we conceptualize attention as teachers' beliefs that gamification will help them to draw learners' attention to the learning materials. Players´ attention in game-based learning has been found to be correlated to learning effects (Juan and Chao 2015). In a study conducted by Wang (2015) using Kahoot! students reported that they got more engaged in the lecture "when it was spiced up with something fun and exciting that made it possible to keep or re-establish the attention" (p. 224). We assume that if teachers perceive that gamification has positive learning outcomes in their students this belief will affect teachers' attitude towards gamification. Therefore the following hypothesis is posit:

> *H2: teachers' beliefs of gamification capacity to draw students' attention will affect teachers' attitude towards gamification.*

*Attention and relevance*

As far as we know no previous research has tested the relationship between attention and relevance in the ARCS framework. We assume that teachers' beliefs of gamification capacity to draw students' attention to the learning materials and activities will affect teachers' perceived relevance of gamification in their courses because the capacity of drawing students' attention in the learning process is a desirable outcome for teachers. Therefore, the following hypothesis is posit:

*H3: teachers' beliefs of gamification capacity to draw students' attention will affect teachers' perceived relevance of gamification.*

*Attention and intention to use*

Previous research has found that gamified learning draw learners' attention and was a strong predictor for learning achievement (Su and Cheng 2015). We assume that teachers' beliefs that gamification has a positive effect in attracting students' attention will affect teachers' intention to use gamification in their courses. Therefore, the following hypothesis is posit:

*H4: teachers' beliefs of gamification capacity to draw students' attention will affect teachers' intention to use gamification.*

## 3. Method

Data was gathered through an online questionnaire. Snowball sampling (Goodman 1961; Biernacki and Waldorf 1981) was used for selection of respondents in this study. Although snowball sampling is unlikely to obtain a representative sample because there is no real control of the snowball effect (Hall and Hall 1996) this form of sampling is often used in online questionnaires to target hard-to-reach population subgroups (Sadler, Lee, Lim, and Fullerton 2010).

*Sample*

A total of 312 teachers serving in higher education institutions completed the online questionnaire. The age of the participants ranges between 26 and 65 years, with an average of 42.8 years and 52.4% are males.

*Measures*

All items used to develop the questionnaire were adapted from existing scales: five items were adapted from Su & Cheng's (2105) ARCS questionnaire to measure attention; three items were adapted from Su & Cheng's (2105) ARCS questionnaire to measure relevance; three items were adapted from Chattopadhyay and Basu (1990) to measure attitude towards gamification; and three items were adapted from Shimp and Kavas (1984) to measure intention to use gamification. All questionnaire items were measured using a 5-point Likert-type scale where (1) = strongly disagree, and (5) = strongly agree.

Tables 1 and 2 show the results for measurement model reliability and convergent validity. Indicators demonstrate the high internal consistency of the constructs. In each case, Cronbach's alpha (1951) exceeded Nunnally and Bernstein's (1994) recommendation of .70. Composite reliability represents the shared variance among a set of observed variables measuring an underlying construct (Fornell and Larcker, 1981). Generally, a composite reliability of at least .70 is considered desirable (Bagozzi and Yi, 1988). This requirement is met for every factor. Average variance extracted (AVE) was also calculated for each construct, resulting in AVEs greater than .50 (Fornell and Larcker, 1981). As evidence of convergent validity, results indicate that all items are significantly ($p<.01$) related to their hypothesized factors, and the size of all the standardized loadings are higher than .60 (Bagozzi and Yi, 1988).

**Table 1:** Reliability and convergent validity

| Factor | ITEM | Standardized loading | t value (bootstrap) | CA | CR | AVE |
|---|---|---|---|---|---|---|
| Attention | ATTE1 | 0,91** | 47,3 | 0,94 | 0,96 | 0,82 |
| | ATTE2 | 0,94** | 68,2 | | | |
| | ATTE3 | 0,90** | 45,1 | | | |
| | ATTE4 | 0,93** | 60,9 | | | |
| | ATTE5 | 0,84** | 25,5 | | | |
| Attitude | ATT1 | 0,94** | 65,8 | 0,96 | 0,97 | 0,92 |
| | ATT2 | 0,98** | 208,3 | | | |
| | ATT3 | 0,95** | 67,7 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Intention | INT1 | 0,91** | 82,4 | 0,87 | 0,92 | 0,79 |
| | INT2 | 0,92** | 64,9 | | | |
| | INT3 | 0,83** | 17,5 | | | |
| Relevance | REL1 | 0,89** | 48,2 | 0,84 | 0,9 | 0,76 |
| | REL2 | 0,81** | 19,6 | | | |
| | REL3 | 0,91** | 60,1 | | | |

**p<0.01

Note: CA=Cronbach's alpha; CR=Composite reliability; AVE=Average Variance Extracted

Evidence for discriminant validity of the measures (Table 2) was tested checking that the shared variance between pairs of constructs was always less than the corresponding AVE (Fornell and Larcker, 1981). We also apply the criterion proposed by Henseler, Ringle and Sarstedt (2014) according to which the HTMT ratio should be lower than .90. No special problems arise. On the basis of these criteria, we concluded that the measures in the study provided sufficient evidence of reliability, convergent and discriminant validity.

**Table 2:** Discriminant validity

| Factor | F1 | F2 | F3 | F4 |
|---|---|---|---|---|
| F1. Attention | 0,90 | 0,69 | 0,81 | 0,82 |
| F2. Attitude | 0,66 | 0,96 | 0,88 | 0,65 |
| F3. Intention | 0,72 | 0,81 | 0,89 | 0,74 |
| F4. Relevance | 0,83 | 0,59 | 0,62 | 0,87 |
| | | | | |

Note: diagonal, square root of AVE; Lower triangle: latent variable correlations

Upper triangle: HTMT ratio

## 4. Results

Table 3 shows the results of the estimation of the research model. Results indicate that attention influences attitude in a significant and positive way (H2; β = 0.54; p <.01; Accepted). Results also indicate that attention influences relevance in a significant and positive way (H3; β = 0.83; p <.01; Accepted). Attention also influences intention to use in a significant and positive way (H4; β = 0.81; p <.01; Accepted). Relevance was not found to influence attitude towards gamification (H1; β = 0.14; p <.01; Rejected).

**Table 3**: Hypotheses testing

| Hypothesis | Standardized beta | | t value (bootstrap) |
|---|---|---|---|
| H1. Relevance-->Attitude | 0,14 | | 1,36 |
| H2. Attention-->Attitude | 0,54** | | 5,04 |
| H3. Attention --> Relevance | 0,83** | | 26,81 |
| H4. Attention-->Intention | 0,81** | | 24,31 |

**p<0.01

$R^2$(Attitude)= 0,435; $R^2$(Relevance)=0,689; $R^2$(Intention)=0,653

$Q^2$(Attitude)= 0,392; $Q^2$(Relevance)=0,511; $Q^2$(Intention)=0,509

## 5. Discussion

The results of this study suggest the important role of attention both in attitude and intention to use gamification. Broadly speaking, teachers believing that gamification can be used to draw students' attention have positive attitude and intention to use gamification. Attention also affects teachers' perceived relevance of gamification, this is, teachers' beliefs in the capacity of gamification to draw students' attention seems to affect teachers' perceived relevance of gamification in their courses. Surprisingly teachers' perceived relevance was not found to affect teachers' attitude towards gamification. Why teachers' perceived relevance of gamification is not affecting their attitudes deserves a deeper attention in future research. One possible explanation is that teachers found easier to value gamification as attention-driver than gamification as relevance-driver for students learning process.

## 6. Conclusions, limitations and future research

As gamification is attracting an increasing attention among teachers as a means to motivate and to engage students in their learning process more research is needed to better understand factors affecting teachers' attitude and intention to use gamification in their courses. This study analyses two key factors in motivation to learning (attention and relevance) as antecedents of teachers' attitude towards gamification and teachers' behavioral intention to use gamification in their courses. Our results suggest that teachers' beliefs of gamification capacity to draw students' attention play a key role in both teachers' attitude towards gamification and teachers' behavioral intention to use gamification in their courses. Moreover, attention also affects teachers' perceived relevance of gamification in students learning process. These results suggest that a great attention must be paid to all design elements in gamification (or educational games) which are able to catch students' attention (for example, visual designs such as images or animations but also game dynamics which enhance students learning experience through attractive gamified materials). One surprising result of this study is that unexpectedly perceived relevance was not found to influence teachers' attitude towards gamification. Maybe teachers' beliefs are that catching students' attention using gamification will be enough to achieve positive learning outcomes but teachers are less confident in how gamified materials are relevant *per se* (without attracting students' attention for example using visually-appealing gamified materials).

One main limitation of this study is the convenience sample used. Although a sample of 312 higher education institutions teachers is big enough for exploratory research the convenience sample used does not allow for generalization of our findings. Future research should use a representative sample of higher education institutions teachers in order to generalize these findings to the target population. It is well known that there are gender differences in video games attitude and usage so future research should analyze the moderating role of gender in both attitude towards gamification and intention to use gamification.

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# Using Computer-Based Simulation Games to Improve the Competencies of MPA Graduates

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**Abstract:** Computer simulation, an active learning technique, is now one of the advanced pedagogical technologies. The use of simulation games in the educational process allows students to gain a firsthand understanding of the processes of real life. Public administration, public policy, and political science courses increasingly adopt simulation games in universities worldwide. Besides person-to-person simulation games, there are computer-based simulations in public administration education. Currently in Russia the use of computer-based simulation games in Master of Public Administration (MPA) curricula is quite limited. This paper focuses on computer-based simulation games for students of MPA programs. Our aim was to analyze outcomes of implementing such games in MPA curricula. We have done so by (1) developing three computer-based simulation games about allocating public finances, (2) testing the games in the learning process, and (3) conducting a posttest examination to evaluate the effect of simulation games on students' knowledge of municipal finances. This study was conducted in the National Research University Higher School of Economics (HSE) and in the Russian Presidential Academy of National Economy and Public Administration (RANEPA) during the period September to December 2015, in Saint Petersburg, Russia. Two groups of students were randomly selected in each university and then randomly allocated either to the experimental or the control group. In control groups (n=12 in HSE, n=13 in RANEPA) students had traditional lectures. In experimental groups (n=12 in HSE, n=13 in RANEPA) students played three simulation games apart from traditional lectures. This exploratory research shows that the use of computer-based simulation games in MPA curricula can improve students' outcomes by 38%. In general, the experimental groups had better performance on the posttest examination (figure 2). Students in the HSE experimental group had 27.5% better scores than students in the HSE control group. Students of the RANEPA experimental group had 38.0% better scores than students in the RANEPA control group. Research indicates that lecture-based courses are less effective than courses with more interactive approaches. Therefore, our study highlights the need to implement computer-based simulation games in MPA programs in Russian universities. Computer-based simulation games provide students with practical skills for their future careers.

**Keywords:** active learning, simulation, computer-based simulation games, students of MPA programs, public administration, municipal finance

## 1. Introduction and problem statement

The implementation of IT in the educational process and daily life transforms methods of gaining knowledge. Students are accustomed to obtaining information and exchanging opinions by way of various electronic devices. It is essential to take into consideration these trends and to implement active learning technologies to effectively teach the current generation.

Computer simulation games are an advanced pedagogical technology. The use of simulation games in the educational process allows students to gain firsthand understanding of the processes of real life. Simulation games allow students to get closer to reality and to practice their knowledge in an interesting way, to learn about interpersonal interaction and collective decision making, and to understand that the individual bears responsibility for decisions made or not made.

Pedagogically, this suggests the use of active learning in the educational process. Chris (2012) states that active learning means the engagement of students in the learning process. Students think about what they are doing. There are such active learning techniques as "problem-solving exercises, informal small groups, simulations, case studies, role-playing" (Meyers & Jones, 1993). Active learning techniques contribute to "both a comprehensive understanding of course material and the skills they need to excel" (Auster & Wylie, 2006). Moreover, active learning "stimulate student's curiosity and boost self-confidence" (Wolfe, 2006).

Chris (2012) has noticed that public administration, public policy, and political science courses increasingly adopt different types of active learning, but the major type they turn to is simulation. In this study attention is paid to the simulation games. Fasli and Michalakopoulos (2006) indicate that nowadays there is no standard classification of games. After reviewing the experience of implementing simulation games and exercises in curricula, we concluded that all simulation games could be divided into several groups, depending on the type of subject that is simulated. One group of simulations could be called *person-to-person simulation games;* in these only people take part. Person-to-person simulation games in public administration and public policy fields have been very widely studied. For instance, Shellman (2001) implemented coalition-formation simulation in his course “Introduction to Comparative Politics.” This simulation aimed to introduce students to major concepts and theories of coalition-formation process. Grummel (2003) explored the effect of policymaking process simulation during courses on policy formulation. Kanner describes the use of political negotiation simulation, the purpose of which was “to reinforce theories of conflict and cooperation within an anarchic environment” (Kanner, 2007). Chris (2012) also mentioned studies of several simulation games used in courses such as professional development, economics, and government.

Another type of simulation games is computer-based simulations in public administration education. In such games, the interaction is between the computer and a person. They are *person-to-computer simulation games*. Computer-based simulations frequently exist in a computer game format. Weir & Baranowski (2011) asserted that computerized simulations are better for the learning process than noncomputerized simulations. For one thing, they are easier to set up; in addition, such games can be saved to analyze interactions. Computer games in the field of public administration have been used in classes at USA universities since the 1990s (Faria, 1986).

Among recent studies, we could refer to Lengwiler (2004) monetary policy simulation game in which student acts like a real monetary authority. Hsieh et al.’s (2006) describe a CASMIM, which is a small-world computation simulation model in which disease parameters and public health policies are manipulated. Weir and Baranowski (2011) describe their experience of integrating the computer-based simulation game *Civilization* into an international relations course. Hu et al. (2012) summarized the implementation of computer-based simulation games in public administration education. The authors mention the educational programs of universities in different countries of the world, in which computer game simulation has been used to help students understand transport management, emergency management, environmental management, urban planning, and so forth. Syracuse University holds an annual competition with the use of simulation games on topics of public administration. Harding, Garrett & Wang (2015) demonstrate the computer-simulation game about decision-making within legal frameworks.

While the literature offers broad insight into the impact of simulation games on MPA students in Europe and the USA, the experience of Russian universities is not represented. Currently, the teaching of public and municipal administration disciplines in Russia involves simulation games to a very limited extent. The main reason is the "theoretical overload" of curricula, which are focused primarily on knowledge and memorization and only secondarily on skills and competencies. To make effective decisions, however, state and municipal officials must not only have a thorough knowledge of the legal framework and of economic governance instruments; they must also be able to navigate in a complex socioeconomic and political reality. To gain practical skills, they need to be placed in an environment that reflects the actual situation as closely as possible, that is, we need to put undergraduates in a learning environment that simulates their future professional sphere.

Pregraduation internship is typically called the reservoir of practice-oriented education in Russia. However, as shown by our intra-university research, graduate students are often used as a technical workforce in committees and administrative bodies: they make copies, sort documents, translate texts, or prepare office memos. Only in exceptional cases are they allowed to participate in administrative decision making or in the process of preparation to make such decisions. We propose changing the approach to MPA program education in Russia through introduction of simulation games. The use of games is fully consistent with the development of those competencies that are laid down in educational standards for MPA training.

Our focus in this paper is on the use of computer-based simulation games for MPA students, and our aim was to analyze the outcomes of implementing games in an MPA curriculum. Our interest was due primarily to the practical need to improve education in public administration. For five years, we have being working together as a teacher-and-student team, and so having the full range of evaluations of the various learning techniques. Despite being on opposite sides of-the educational process, we agreed that the need to spread education in the practical side is immediate and obvious. The first attempts to use online games in the educational process have shown to be successful, so we decided to continue to develop them in more detail. For this research, we have carried out our analysis by (1) developing three computer-based simulation games about allocating public finances, (2) testing games in the learning process, and (3) conducting a questionnaire survey of MPA students who studied the same course with and without the computer-based simulation games. This exploratory research shows that the use of computer-based simulation games in MPA curricula improves students' outcomes. Therefore, our study highlights the need to implement simulation games in MPA programs. In the rest of the paper, we first describe our games and then present results of their implementation.

## 2. Description of computer-based simulation games

The financial sector in public administration is one of the most important for understanding and successful professional performance. In the framework of a master's degree program, it is necessary to develop practical skills both in the analysis of socioeconomic situations in the region and in budget adoption and implementation. We believe it is important to introduce computer-based simulation games dealing with municipal finances into the educational process in the field of public administration.

### 2.1 Game software and the IT-developer

The development of computer-based simulation games has been carried out on the basis of a gaming platform provided by the MG System Company (http://busybird.ru/mg/course/компания-мг-систем/). MG System is a developer of training software (business simulators, simulators, training, and business games) in Russia. The company is headquartered in the city of Togliatti, in the south of the European part of Russia. The company manages projects across Russia as well as abroad. Under the preliminary agreement between the project initiators and the developers, MG System has provided a computer-based simulation game template. The template is a table with data that are reflected in the game. The company uploaded templates on its platform, and we filled them with content necessary for allocation-of-municipal-finances games. Each game is located at a link, access to which is granted by the company.

### 2.2 The content and structure of games

To enhance learning outcomes we developed together with students three games on the subject of municipal budgets. Bovill, Cook-Sather and Felten (2011) state that co-creation develops a student's meta-cognitive awareness about what is being done.

Three gaming scenarios give students the opportunity to practice the allocation of budgets in various types of municipal structures. Every type of municipal structure has its particularities. The three different simulators provide the opportunity to understand, feel, and remember the difference. The following municipalities are distinguished in Russia at the local level: rural settlements, urban settlements, and intracity areas of a city of federal importance.

The first gaming scenario was developed for rural-settlement budget management. Rural settlement is one or several rural-type settlements that are united by common territory (townships, villages, stanitsas, hamlets, farm yards, kishlaks, auls). The second gaming scenario is related to an urban settlement, a town or other urban-type settlement. The third scenario reflects budget management for an intracity area of a city of federal importance, which is part of the territory of a city of federal importance. Playing through these scenarios, undergraduates will be able to understand the administrative diversity of municipalities in the Russian Federation, to understand their specificity, and to test options for administrative decisions in each case.

During the process of playing, the students will "put themselves in the shoes" of a mayor. The game can be played either by an individual student (one participant = one mayor = one computer) or by a group of students. In the latter case, it becomes a team game, a multiplayer game (a group of participants = one mayor). The participants make decisions as a group on budget distribution. The choice of individual or multiplayer mode depends on the preferences of instructor and on the number of students in the group. All the students play simultaneously. The students govern one and the same city (depending on the playscript), but with the use of different strategies. All the actions are performed in real-time mode.

Each game comprises 12 periods, and each period imitates one year's duration. A period is a case situation that has to be solved. The time for decision making for each period is strictly limited by the teacher in the game settings. This means that the players are not able to turn the game back by one period and then continue entering the solution. The periods start and end at the same time for all the students. There is a strict deadline in the game.

We specified various government regulations in the contents of the periods and included experts' assessment of the significance of the municipal economy areas, and other input data. The participants need this information to make decisions on budget distribution. Just as in real life, a player has deputies who bring in new information about what is going on in the city after every period. In addition, during every period the player studies the results of polling among the citizens. All of this information has been compiled by us in advance for each period and for each playscript. In the process of playing, the master's degree students learn to use and apply the form of road map, variants of the city executive board's report on implementing the road map of the social and economic development of the city, the form of PEST analysis, the form of SWOT analysis, and the task recording sheet.

The participants distribute the city's budget in each period to five key sectors: (1) utilities sector and land improvements; (2) road facilities and urban transport; (3) health care and social security; (4) education and culture; and (5) development of the economy. All the periods are interconnected in a mathematical model. If the participants overlook information containing prompts on budget distribution, their city's budget revenue for the next "year" becomes lower than in the previous period. The city's rating is changed subsequently. After each period the participants can learn which city is the best one and receive an award for the most efficient distribution of the city's budget revenue. Participants can also analyze where an error was committed (on their own or with the teacher's help).

## 2.3 The game process

The games are launched in online mode by the teacher. The teacher is the game administrator and sets such parameters of the game as the game period duration and the number of players connected to the simulator. The teacher launches the game. To play the games, only computers connected to the Internet are needed. One can enter the game from any device that has an Internet connection. All the solutions entered by the teams are saved automatically. Only the information for decision making is changed in the periods. The participants get acquainted with the relevant information and work out a variant of budget revenue distribution. Distribution requires doing simple mathematical calculations. The participants enter the sums allocated for each sector in the player space directly, in the period screen (Figure 1). In the first period, the budget size is the same for all the players. In the other periods, the dynamics of all the participants' budget revenue changes are seen. In some periods, players must fill in additional information analysis forms (road map, task recording sheet, etc.). The students fill in the forms suggested in the period screens in their practice books. Schematically, the process of passing through a period can be seen in Figure 2).

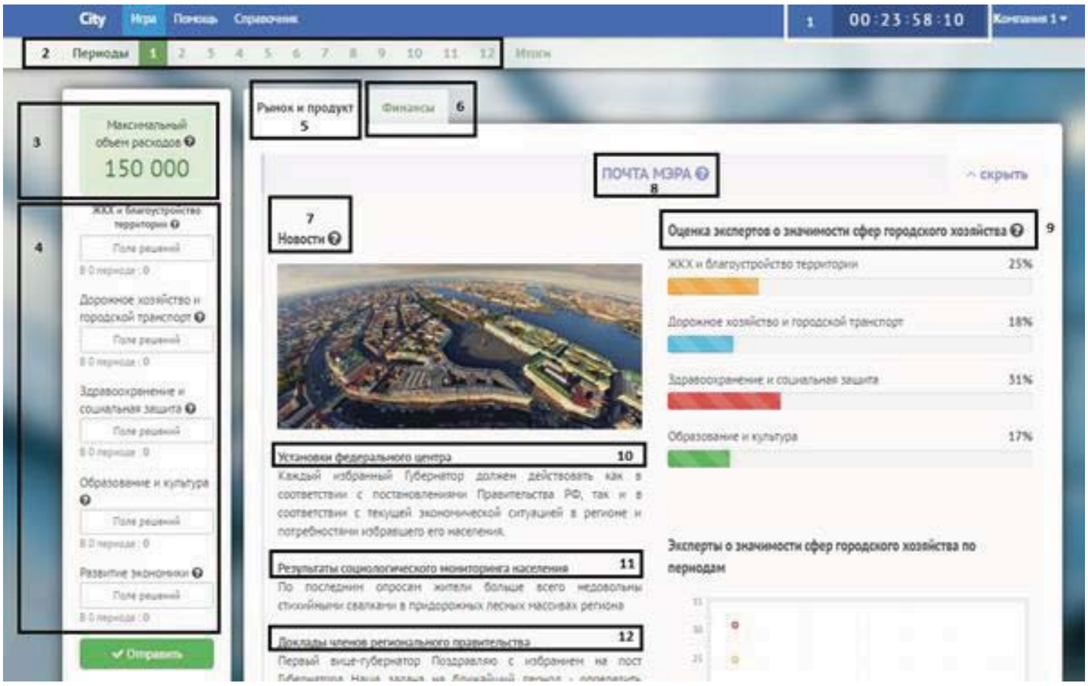


**Figure 1:** The screenshot of the main page of the game (1st period out of 12)

Comments: 1: the time counter; 2: the line of periods of the game; 3: the budget of the municipal entity for the current period; 4: the fields for typing in the solutions in five areas of spending of the municipal budget; 5: the main tab; 6: the tab "Finance" (the report on the execution of the budget); 7: the news of the first game period; 8: the mayor's mail; 9: expert assessment of the importance of four spheres of governance in municipal entity (a chart); 10: policy of Federal centre; 11: results of sociological monitoring of the population; 12: reports from members of the government.

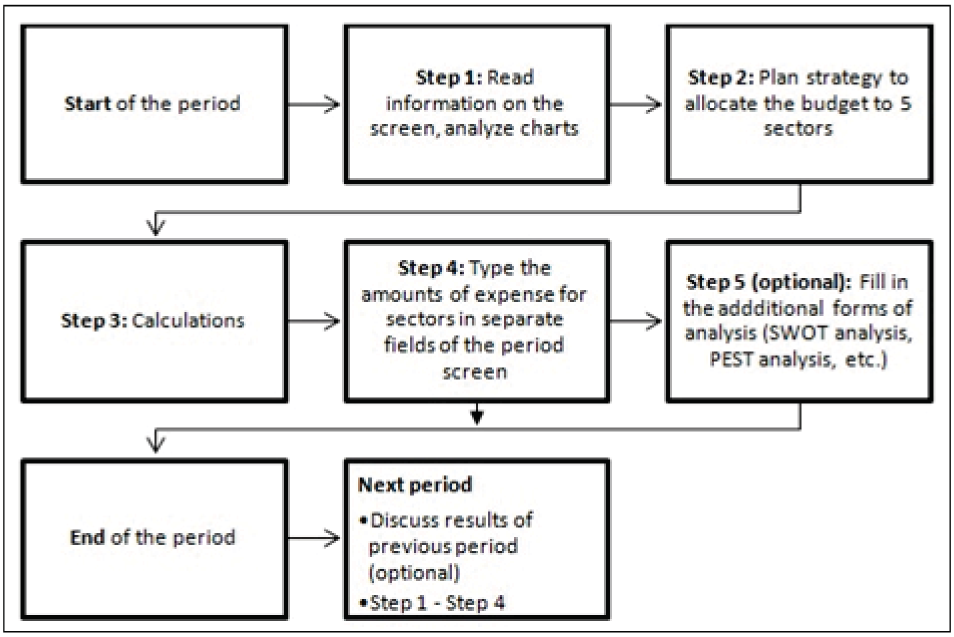


**Figure 2:** The period flowchart

## 3. Data and method

We decided to teach courses using computer-based simulation games to analyze the outcome of implementing games in MPA curricula. We tested the implementation of games in the municipal governance courses for first-year students of MPA programs. This study was conducted in the National Research University Higher School of Economics (HSE) and in the Russian Presidential Academy of National Economy and Public Administration (RANEPA) in Saint Petersburg.

We used posttest examinations to evaluate the effect of simulation games on students' knowledge of municipal finances. Two groups of students were randomly selected in each university and randomly allocated either to the experimental or the control group. In control groups (n=12 in HSE, n=13 in RANEPA) students had traditional lectures. In experimental groups (n=12 in HSE, n=13 in RANEPA) students played three simulation games in addition to traditional lectures.

A structured questionnaire was used to collect the data. The first part was designed to gather demographic data (age, gender, number in the group, university). The second part was the written examination. The exam contained 20 multiple-choice questions on municipal budget. The questions were taken from several sources, such as textbooks, Internet resources, and official documents of government institutions.

Municipal budget knowledge scores were calculated by correct/incorrect responses. Questions 1 to 10 were about theoretical aspects of municipal finance. Questions 11 to 15 concentrated on financial terms used in official documents. Questions 15 to 20 were about administrative decision techniques. The mean municipal budget knowledge scores were calculated for analysis for each question. We calculated the number of correct responses for each question within each group of students. We compared the average number of correct group responses for the exam (in percentages) to determine the difference between the experimental and control groups in the scores of municipal budget knowledge.

## 4. Results

The study sample was distributed almost equally between the genders (female = 27, male = 23). The mean age for the whole sample was 22.3. Results of the exam show several interesting observations (table 1). First, all four groups of students remembered the theoretical aspects of municipal finance at a good level. Therefore, memorizing theoretical material is more connected with lecture time.

Second, both control groups gave significantly fewer correct responses to questions about financial terms that are used in official documents. Students in the HSE control group dealt with this type of questions twice as poorly as students in the HSE experimental group. Students in the RANEPA control group gave three times fewer correct answers than students in the RANEPA experimental group to questions 11 to 15. Therefore, we conclude that the simulators that we developed help students to remember the features of the documents of municipal administration. We believe this is an essential skill for success in the students' future professional activity. In addition, this is an important indicator of the effectiveness of using computer-based simulation games for learning aspects of municipal budgets.

Third, the experimental groups had more correct responses to questions about administrative decision techniques. Students in the HSE control group coped with this category of questions 63% worse than students in the HSE experimental group. Students in the RANEPA control group gave 75% fewer correct answers than students in the RANEPA experimental group to questions 11 to 15. We conclude that simulation also helps in understanding administrative decision techniques. The study shows that simulation technique is better for that purpose than lectures.

**Table 1:** The number of correct responses of the groups on each question of the exam test

| Theme of the question in the test | # | The number of correct answers on the question | | | |
|---|---|---|---|---|---|
| | | HSE experimental | HSE control | RANEPA experimental | RANEPA control |
| Theoretical aspects of municipal finance | Question1 | 12 | 12 | 13 | 13 |
| | Question2 | 12 | 12 | 13 | 13 |
| | Question3 | 11 | 11 | 12 | 12 |
| | Question4 | 12 | 12 | 13 | 13 |
| | Question5 | 10 | 11 | 12 | 12 |
| | Question6 | 11 | 12 | 12 | 13 |
| | Question7 | 11 | 12 | 12 | 13 |
| | Question8 | 12 | 11 | 13 | 12 |
| | Question9 | 12 | 12 | 13 | 13 |
| | Question10 | 11 | 11 | 12 | 12 |
| Financial terms in official documents | Question11 | 12 | 5 | 13 | 2 |
| | Question12 | 12 | 6 | 13 | 3 |
| | Question13 | 11 | 4 | 12 | 2 |
| | Question14 | 11 | 5 | 12 | 2 |
| | Question15 | 10 | 6 | 11 | 2 |
| Administrative decision techniques | Question16 | 11 | 3 | 12 | 2 |
| | Question17 | 11 | 4 | 12 | 3 |
| | Question18 | 11 | 5 | 12 | 2 |
| | Question19 | 12 | 3 | 13 | 3 |
| | Question20 | 11 | 3 | 12 | 1 |

Overall, both experimental groups performed better on the exam (Figure 3). Students of the HSE experimental group performed better than students in the HSE control group by 27.5%. Students of the RANEPA experimental group performed better than students in the RANEPA control group by 38.0%. We assume that the difference between the control groups is connected with the students' level of knowledge before the course. A limitation of the study is that we did not administer a pretest to check the knowledge of students in HSE and RANEPA. We did not include in a structured questionnaire questions about previous courses. As we discovered, students in HSE had previously taken a course on government finance. The difference between the performance of the control groups could also be connected with the quality of teaching. However, that issue is beyond the scope of this study.

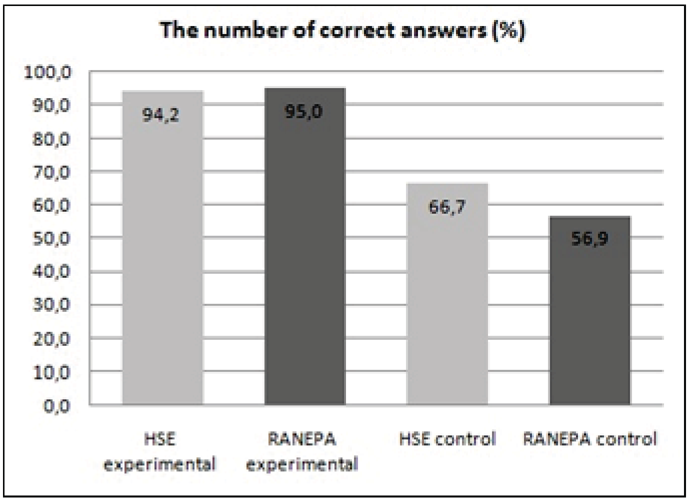


**Figure 3:** The percentage of correct responses for the exam in the experimental and control groups

## 5. Competency-based approach and computer-based simulation games for MPA students

Simulations correspond to a competency-based approach in higher education. The use of simulators in teaching about public administration brings graduate students to the field of budget allocation. Therefore, our next step was to indicate how the simulation allows students to gain competence in compliance with educational standards concerning public administration. For this purpose, we have conducted 6 semi-structured interviews (3 in HSE and 3 in RANEPA) with the teachers involved to the education in public administration. We have described them a conception of the game, and then demonstrated them some parts of the game process, as well as the results of the posttest examinations. Our goal was to identify concrete competencies from educational standards, which could be associated with the computer simulation games on budget allocation.

It is important to note that in Russia there are two types of educational standards. The first one is the Federal state educational standard (FSES). It is obligatory for all universities in the country, except for several universities. There is a Federal state educational standard for MPA programs. Only a few universities in the country have the right to develop their own educational standards that are different from the FSES. These original standards are the second type of exciting educational standards in the country. The requirements of these standards are higher than the requirements of the Federal state educational standard. National Research University Higher School of Economics refers to the number of universities that have their own educational standards. The original educational standards in HSE (OS HSE) are developed for all existing university fields of study, including public administration. RANEPA, on the other hand, uses FSES in the educational process.

In Russia, requirements pertaining to the learning outcomes of the graduate programs are expressed by a list of competencies in the educational standards. There are 26 competencies in the Federal state educational standard (dated November 2014) for public administration programs. They are divided into three groups: (1) general cultural competencies (GCC, n=3), (2) general professional competencies (GPC, n=3), and (3) professional competencies (PC, n=20). General cultural competencies of master's degree students are associated with civil behaviour and ethics, the organization of studies, and self-improvement. General professional competencies are associated with professional communication and its organization. Professional competencies are closely related to the field of public administration. Basing on our study, the FSES competencies for MPA programs that are listed below could be achieved with the help of computer-based simulation games:

- abstract thinking, analysis, synthesis (GCC-1);
- the ability to analyze, plan, and organize professional activity (GPC-1);
- organizational skills, the ability make organizational management decisions (PC-2);
- the ability to analyze and plan in the field of state and municipal governance (PC-4);
- knowledge of modern methods of diagnosis, analysis, and solution of socioeconomic problems, as well as methods of making decisions and their implementation in practice (PC-5);
- the ability to carry out verification and structuring of information obtained from different sources (PC-11);

- the ability to use information technologies for various research and administrative tasks (PC-12);
- the ability to critically evaluate information and constructively make decisions on the basis of analysis and synthesis (PC-13);
- the ability to organize and summarize information for improving the system of state and municipal administration (PC-14);
- the ability to put forward innovative ideas and creative approaches to their implementation (PC-15);
- knowledge about methods for analytical work and research (PC-18).

There are 31 competencies in the original educational standard in HSE for MPA program. They are divided into two groups: (1) systemic competencies (SC, n=8) and (2) professional competencies (PC, n=23). Professional competencies are closely related to the field of public administration. Systemic competencies are related to the use of various methods and tools of research in professional activity, interpersonal interaction, and dealing with information. MPA graduates from HSE could gain the following competencies through the use of computer-based simulation games:

- the ability to make management decisions, evaluate their possible consequences, and feel responsibility (SC-5);
- the ability to analyze, verify, and assess the completeness of information in professional activities and, if necessary, to obtain and synthesize the missing information and work in conditions of uncertainty (SC-6);
- the ability to organize multilateral (including intercultural) communication and manage it (SC-7)
- the ability to lead, control, and coordinate activities in different spheres of public and municipal administration (PC-12);
- the ability to maintain managerial and financial reporting in various spheres of state and municipal control (PC-13);
- the ability to carry out financial planning, to form budgets in various spheres of state and municipal administration (PC-14);
- the ability to carry out complex analysis of problems of state and municipal management (PC-15);
- the ability to make and implement management decisions in conditions of limited time and incomplete information (PC-16);
- the ability to effectively use modern information and communication technologies (PC-19);
- the ability to carry out the verification, structuring, and critical evaluation of information obtained from various sources, and perform analysis and synthesis of management decisions in the field of state and municipal administration (PC-22).

## 6. Conclusion

Despite this study does some contribution in the research and practice of computer-based simulation games in public administration education, it obviously has some of the limitations. First, these are limitations, which relate to regional and institutional particularities. We have tested only two Universities in the same region (St. Petersburg), and the number of students in the sample is rather small. We can suppose that a different distribution is expected in other Universities of Russia. The second limitation concerns the necessity of having a pre-test survey to understand students' prior knowledge of the subject. A third limitation is due to the fact that we do not have any data which could link to students' experience and engagement which are also very important for the educational process. In the next studies, we are going to measure the students' respond for the usability, interface, digital literacy and other issues concerning some subjective aspects of the computer-based simulation games.

However, in general our study shows that computer-based simulation games on municipal finance for students of MPA programs not only improve their knowledge but also contribute to the gaining of many other skills. Computer-based simulation games contribute to an effective learning process.

## Acknowledgements

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# A Teaching Model Using Social Network Sites

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**Abstract:** New media and social network sites (SNSs) currently play an important role in our society and in our daily practices (Boyd and Ellison 2008; Lister et al 2009; Watkins 2009; Papacharissi 2011). This necessarily affects the way we learn together, as explored in research spanning several areas. Regarding higher education, Facebook has an increasingly prominent position and is more widely investigated as an instructional tool in the college classroom than most SNSs (Tess 2013). From the perspective of teaching and learning, the Web 2.0 is seen as an enabler of a vision in which the student will find information potentially contradicting the knowledge acquired through the traditional formal learning process (Santos 2009). This feature leads to a continuous discussion of the facts, topics and subjects having an awareness of a common range of formal established knowledge shared in a given community and, at the same time, the joint reflection and debate within this same community. This new reality, in which the roles of the teacher and the student (or the roles of who teaches and who learns) become fuzzy, difficult to distinguish clearly, also brings the need for new ways to understand, describe, and explain the learning process and the ways in which it develops. In this paper we use the concept of social e-learning (Martins et al. 2012), building on the connectivist perspective (Siemens 2004, 2006, 2008). Social e-learning can be considered as a learning process whereby the Internet represents a space for participation, sharing, and collaboration, with new opportunities to create, share content, and interact with others (Bennett 2012) – an open door to build more open and flexible knowledge, where students build and rebuild their own path. A concrete format for its implementation is proposed and a genuine experience is presented and discussed. The social e-learning model presented in this article has been successfully applied in a training course in the field of business communication, held by Citeforma. Citeforma is a Portuguese vocational training centre, jointly managed by SITESE (a services workers and technicians union) and IEFP (the Portuguese Institute for Employment and Vocational Training).

**Keywords**: social learning, Web 2.0, social media, social network sites, education, learning communities

## 1. Introduction

New media and social network sites (SNSs) currently play an important role in our society and in our daily practices (Boyd and Ellison 2008; Lister et al. 2009; Watkins 2009; Papacharissi 2011). This necessarily affects the way we learn together, as explored in research spanning several areas. Regarding higher education, Facebook has an increasingly prominent position and is more widely investigated as an instructional tool in the college classroom than most SNSs (Tess 2013:).

Areas covered include education and learning processes in the medical and health sector (Cain and Policastri 2011; Pimmer et al. 2012; Tower et al. 2015), humanities and the social sciences (VanDoorn and Eklund 2013), business studies (Arquero and Romero-Frias 2013), language learning (Kabilan et al. 2010) and teacher education (Wang et al. 2012), among many others, with several models and variables for adoption (Martins et al 2015).

From the perspective of teaching and learning, the Web 2.0 is seen as an enabler of a vision in which the student will find information potentially contradicting the knowledge acquired through the traditional formal learning process (Santos 2009). This feature leads to a continuous discussion of the facts, topics and subjects having an awareness of a common range of formal established knowledge shared in a given community and, at the same time, the joint reflection and debate within this same community.

This new reality, in which the roles of the teacher and the student (or the roles of who teaches and who learns) become fuzzy, difficult to distinguish clearly, also brings the need for new ways to understand, describe, and explain the learning process and the ways in which it develops.

From a technological standpoint, e-learning is supported by the Internet and its publication and communication services. From a pedagogical perspective, e-learning implies the existence of an interaction model between teacher and student – and in some cases an additional interaction model oriented to the interaction among students (Anderson 2002, Martins and Kellermans 2004, Gomes 2005).

In this paper we use the concept of social e-learning (Martins et al. 2012), building on the connectivist perspective (Siemens 2004, 2006, 2008). A concrete format for its implementation is proposed and a genuine experience is presented and discussed.

## 2. About social e-learning

Connectivism, as proposed by Siemens (2004), can be considered as a new learning theory for the digital age. Central to this perspective is the assumption that knowledge is distributed in a network of connections. Learning, therefore, consists of the ability to build these networks and use them regularly (Downes 2007). It is in this context, in which the agent of the learning process is the center of a network, that the concept of Personal Learning Environment emerges.

It is possible to consider new scenarios for e-learning. These scenarios include the replacement of traditional Learning Management Systems (LMS) by other platforms with different architectures, integrating in the learning process tools that students are already familiar with from their daily interaction on SNSs. With these tools, available through SNSs and used by students in their daily practices, the learning process can become closer to an informal environment.

Despite tensions that are probably inherent to the differences between resources available through SNSs and traditional educational practices, we can consider the hypothesis that social e-learning can contribute to a greater autonomy on the part of students in the pursuit of knowledge, perhaps helping to find new ways for students to engage in individual and collaborative learning activities and providing new channels for the debate associated with the learning process (Alexander 2006, Armstrong and Franklin 2008, Junior and Coutinho 2009, Committee of Inquiry into the Changing Learner Experience 2009, Bennett 2012).

Ausubel, Hanesian and Novak (1978) argue that learning is largely a meaningfull process, in which the student joins new knowledge to relevant existing knowledge. New knowledge must interact with the relevant concepts already existing in the student's perception of reality, and learning is therefore seen as a progressive process based on experience.

This active learning, based on the creation, communication, and participation in communities, is particularly suited to the profile of the current student - which is, mostly, a regular Internet user and an active participant in SNSs.

Social e-learning can be considered, in this sense, as a learning process whereby the Internet represents a space for participation, sharing, and collaboration, with new opportunities to create, share content, and interact with others (Bennett 2012) – an open door to build more open and flexible knowledge, where students build and rebuild their own path.

In this way of organizing the learning process, there is some evidence supporting the shift of control from the teacher to the students, with pedagogical approaches focused on them and their expectations, needs, and characteristics (Mota 2009). Additionally, the integration into a group connected and supported through a social network site probably enhances the creation of a sense of belonging and group cohesion, allowing for the group to continue its activities for as long as the members wish to – even after the official conclusion of a specific learning process.

Social e-learning enables the creation of more personalized learning environments, adapted to student profiles, and places at the teacher’s disposal a range of free tools for communication and simultaneously promotes the group's integration in virtual communities with shared interests and needs (Junior and Coutinho 2008; Santos 2011; Martins et al. 2012).

The implementation of social e-learning solutions enables the acquisition of skills that can therefore probably exceed the actual scope of traditional learning models, while reducing the fixed costs of education and training (Martins et al. 2015).

## 3. Methodology

The above literature review allowed us to discuss the current situation of e-learning, with its main advantages and challenges. This review also allowed us to introduce the concept of social e-learning and discuss some related trends. We now present a design proposal for implementing a social e-learning model, using a design science methodology.

This methodology is commonly used in engineering and computer science research, applied to the creation of models, designing processes and solutions. The design science approach can be used to conceive and validate systems that are not yet operational, by creating, combining, or altering processes, software, and methods to improve existing solutions (Lacerda et al. 2013).

The design-science helps to understand the behavior of information systems by creating new and innovative artifacts (Hevner et al., 2004). Such artifacts, depending on the research, are widely defined by constructs, models, methods and instantiations. In design science, as opposed to explanatory science, academic research can be seen as a quest for understanding and improving human performance (Van Aken, 2005), which constitutes one of the possible applications of artificial life as a discipline and this research in particular.

Hevner et al. (2004) have introduced a set of guidelines for design science research within the discipline of Information Systems. In this dissertation (following the guidelines), an abstract social e-learning model will be considered an artifact. The artifact was validated by a case study.

## 4. Implementation model

The implementation of a social e-learning model can be technically supported by any SNS that allows the creation of private groups, such as Facebook (Santos 2014).

The model we propose has two moments requiring direct, face-to-face, interaction between teacher and students. One occurs at the beginning of the course, in a presentation session. The other is the final session, when the global evaluation takes place.

The initial session provides a moment of physical interaction between the participants before the virtual iterations begin, to explain the course outline and to contribute to an easier inclusion of members in the SNS group, namely through:

- The creation of personal accounts on the SNS, in the event that a student does not already have an account;
- The inclusion of students in the private group created for the course;
- Accepting the invitation to enter the private group;
- The invitation for each participant to make at least one post, with his/her personal presentation, during the first week.

After the initial week the teacher introduces in the private group the topics and subtopics of the course according to the outline. The teacher introduces posts about the subject and encourages students to reply and complement each topic by inserting comments and supporting materials, such as links, text, image and video.

Contents may have different shapes and levels of theoretical depth: books, texts, academic papers, movies, quotes, or observations in short sentences can be used. Upon completion of each topic, the teacher creates a wiki page (using Google Docs, for instance) with the conclusions and contributions of all members, filtered according to what is theoretically and scientifically accepted, and shares the document in the area where all students have read and write permission.

In the final session a written examination is held, focusing on the content shared and discussed during the course.

Figure 1 shows the general structure of a course following this model.

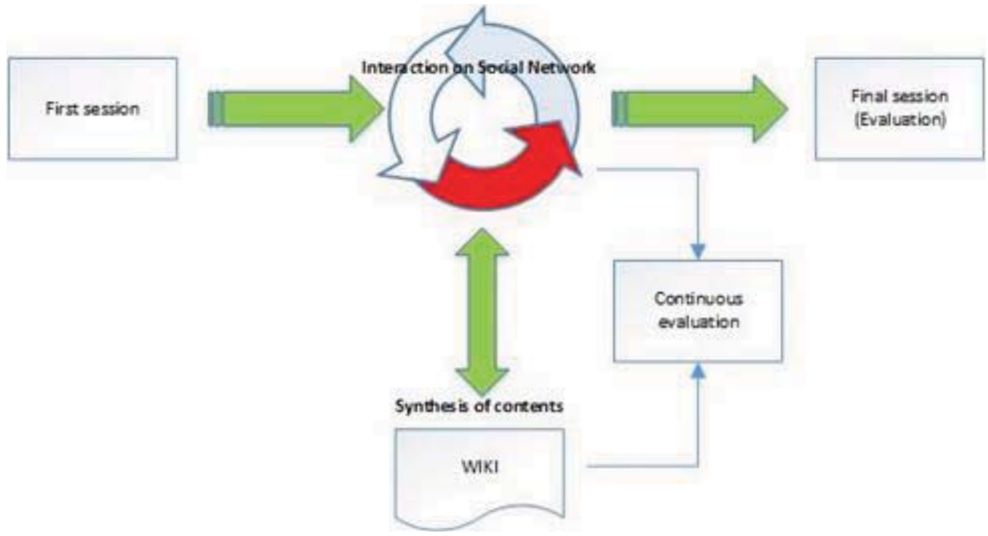



**Figure 1**: Social e-learning model

The teacher should ensure the pace of discussion and presentation of materials, compliance with the outline of the course, and stimulate individual research for information, promoting a self-learning attitude.

Although the teacher is essentialy a facilitator, focused on helping the group to interact and progress in its own way, observing its behavior and contributing occasionally with content, he should intervene whenever:

- There is a shift away from the topics connected with the subject;
- There is a significant loss of quality and scientific precision in the discussion;
- A significant slowdown in group activity occurs;
- It is necessary to strengthen or enforce the rules of participation.

At the end of each topic and after validating student contributions, the teacher is responsible for:

- Completing the contributions;
- Developing an organized summary of contents;
- Creating the wiki page;
- Evaluating students.

The student is expected to conduct his/her own individual desk research, to look for information related to the topics of the course, to contribute with relevant information in the private group and discuss it, participate actively in the group's activity, and encourage the participation of all other stakeholders.

It is assumed that students have availability to participate in the group's activity every two days, as well as to personally attend the first and final sessions. Courtesy toward other members of the group and respect toward different opinions, at all times, are essential prerequisites.

As with other learning models, student evaluation is both qualitative and quantitative (e. g. final grade = participation * 0.4 + written examination * 0.6). The evaluation takes into consideration the result of the written test (online or offline) and the quality of participation and interactions, considering components of attitude and level of participation in the SNS group, for instance.

## 5. Implementation case study

The social e-learning model presented in this article has been successfully applied in a training course in the field of business communication, held by Citeforma. Citeforma is a Portuguese vocational training centre, jointly managed by SITESE (a services workers and technicians union) and IEFP (the Portuguese Institute for Employment and Vocational Training).

This institution has played an important role in innovation in training in Portugal. Examples include the introduction of training courses and, more recently, the creation of a training offer in blended learning (b-learning), combining face-to-face interaction in classroom with computer-mediated activities, using its own methodology and format.

To better fulfill its mission while lowering costs and reaching a wider audience, Citeforma decided to continue its innovation process, focusing on the use of new technologies in its offer and activity. This decision led to the implementation of the course described herein.

The course promotion and selection of students was done institutionally and also through Facebook, with invitations to the network of friends. The guidelines for participation, the course duration, the dates and the evaluation rules were published in advance, through the institutional Citeforma website.

Seventeen participants were selected. Of these, 3 (17.65%) had a master's degree, 11 (64.7%) a bachelor's degree and 3 had no higher education degree; 14 (82.35%) were employed and 3 (17.65%) unemployed.

As defined in the course outline, the presentation session required direct, face-to-face interaction between teacher and students, in a classroom.

The main course objectives were:

- Understanding the importance of communication processes in organizations;
- Reflecting on the various forms of business communication;
- Deepening the most significant aspects of communication policies;
- Understanding some of the fundamental communication technologies.

As the implementation of this course must be considered as a first stage in testing the proposed social e-learning model, good research practices were considered, controlling for variables not directly associated with the methodology that could potentially influence the participants' evaluation of the course. It was therefore decided to use a course topic and outline that would allow for a representative group of participants, ensuring comparability with the courses regularly held in the traditional model of teaching and learning.

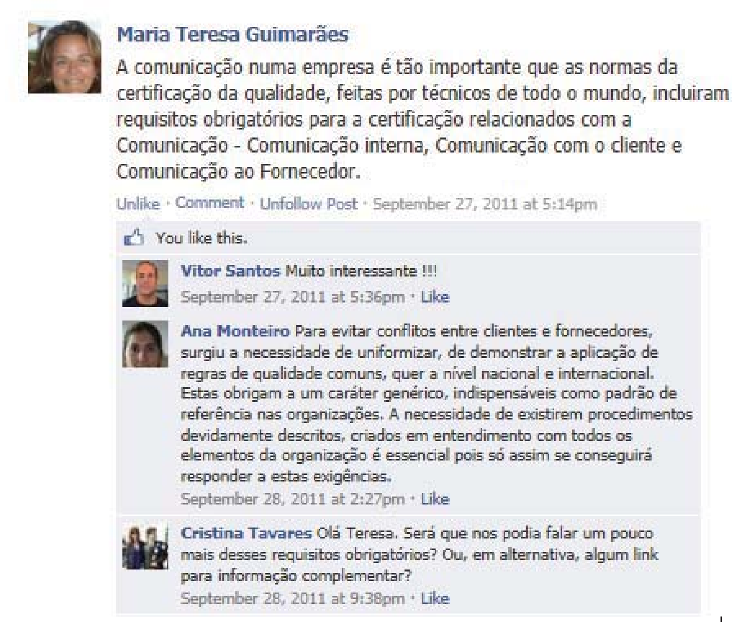
With this in mind, the course had a total of 25 hours, over one month. The presentation session and the final session, held in classroom, were scheduled for a Saturday – a common practice in other Citeforma courses. The remaining sessions were held through the Facebook private group, as considered in the model. Topics and subtopics of the course were introduced progressively, according to the sequence of the course outline.

The course topics were the following:

- The role of communication in the strategy of organizations;
- Business policies, mission, positioning and communication policies;
- Technologies and communication tools in organizations;
- Online marketing;
- Web design;
- Web development technologies and tools;

- Monitoring resources and evaluating communication results.

The teacher placed the initial posts for each topic. The students then added comments and other information (such as links, text, images, or videos), supporting the discussion and the interaction between the group members. Figure 2 shows an example of discussion on the first topic.




**Maria Teresa Guimarães**
The communication inside an enterprise is just as important as the standards of quality assurance made around the globe, including the mandatory rules of certification related to communication – internal communication and communication with clients and suppliers.

**Vitor Santos**
Very interesting!!!

**Ana Monteiro**
In order to avoid conflicts between clients and suppliers, there is a need for uniformity, for demonstration and application of common quality rules, whether at the national or international level. These demand a generic character, but just as indispensable as other standards within the organization. The need for clearly established procedures, created with the input of all of the units in the organization, is essential, and only with them is it possible to address the organization's needs.

**Cristina Tavares**
Hi Teresa. Could we speak a bit more about these mandatory rules? Or, as an alternative, a link to some further information?

**Figure 2**: Interaction example

At the end of each topic an overview of contributions was created, using the teacher's and students' contributions. A wiki page was created, where the overview was shared. Figure 3 shows a printscreen of the wiki homepage.


**Figure 3**: Wiki homepage

The final session was attended by 13 students. The four students who missed the final session did not complete the course, neglecting to deliver the assignment prior to the final session. The course has therefore certified a total of 13 students.

The average grade, on a 0-20 scale, was 16.84, with a minimum score of 14 and a maximum score of 19.

The results of the student feedback questionnaire at the end of the course, on a scale from 1 to 6, are:

- Overall rating: 3.91;

- Objectives and course topics: 3.55;
- Methodology and resources: 3.56;
- Teacher: 4.31.

The end-of-course teacher's evaluation, also on a 1 to 6 scale, was:

- Overall rating: 4.40;
- Organizational issues: 4.50;
- Quality, interest, and participation from the group of students: 3.71.

Note that the students' evaluation regarding aspects directly related to the course implementation are below the average evaluation of the courses held in the same year by Citeforma, which are:

- Overall rating: 5.50;
- Objectives and course topics: 5.24;
- Methodology and resources: 5.21.

The lower average evaluation of this course compared to the other Citeforma courses might be related with the absence of interpersonal interaction during the course (with the exception of the presentation and final sessions). We consider that this can have at least two implications: i) it may reveal new kinds of obstacles in the learning process (for instance, deriving from an asynchronous communication chanel); ii) the students value the classroom interaction, with direct interpersonal communication (not in the learning process, but as a socially gratifying experience).

This was the first course held by Citeforma using such a model, contrasting with courses based completely on classroom sessions. The implications suggested above are consistent with qualitative feedback provided by the students in the final session. But further research is necessary to explore the interaction between these variables.

One variable that can be adapted in order to further explore a connectivist model, if the implications suggested are confirmed, relates to the students' initial expectations regarding the role of the teacher. One adjustment might be to use the first session to adapt the expectations of students towards the teacher's role in the group's activity – building on a model in which the teacher's intervention is not necessarily central, and the students' participation is fundamental, in order to create a regular discussion and group activity.

## 6. Final considerations

We present a model for teaching using social network sites, supported by the concept of social e-learning. This model was tested through the implementation of a pilot course in a vocational training centre.

Although there are still areas for improvement, the implementation experience of this model allowed us to conduct an initial empirical test of the proposed model. This experience allowed us to learn from the process and to confirm that social e-learning models may lead to a scenario that opens the door to a reformulation of the roles played by teacher and students. Such models could allow accessing knowledge and acquiring skills outside the scope of traditional learning models – and at the same reduce the fixed costs for education and training. Additionally, we can also underscore the fact that the integration in a group, on a social network site, can contribute to the creation of a sense of belonging and team spirit, allowing the group and the learning context to endure over time, while the individual participants consider it to be useful and adequate.

The next steps in the development of this model relate with theoretical and practical issues, namely:

*Training of the teacher*

The experience and the data obtained so far show the need to focus on developing the role of this new kind of teacher. According to this new paradigm, the teacher is facing new challenges – like the possibility that the group discussion takes unpredictable directions, not familiar to the teacher. This effect has to be articulated with the need for technical and scientific validation of information found on the Internet, making the teacher also largely someone who is continuously learning.

We developed a pilot course addressing these issues, in 2014, in close collaboration with IEFP (the Portuguese Institute for Employment and Vocational Training). This course sought to familiarize teachers with social e-learning, helping them to:

- Develop effective content on several thematic areas and a training program using the social e-learning format;
- Prepare training sessions according to the social e-learning characteristics;
- Successfully implement training offers using a social e-learning model;
- Evaluate the results by designing and producing assessment tools.

Additional research on these topics is fundamental, however.

*Study the impact of the process experienced by students in terms of their cognitive strategies for learning*

The data obtained so far indicate that the formative process experienced by the students is substantially different from what occurs in other teaching models. Therefore, it is important to develop further research to explore this process and to determine the best strategies and best practices to be adopted by students.

*Explore how a social e-learning model can be implemented in large institutions*

In particular, how can this model contribute to the acquisition of professional skills beyond the scope of traditional learning models, and contribute to lowering the costs of education and business training.

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# Validating a Social Media Typology With Machine Learning and Focus Groups

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**Abstract:** Social media networks (SMN) are an established part of the learning landscape in which our students reside as digital inhabitants. Our work is built around an ongoing four-year survey of student attitudes and engagement with SMN and their educational use. Our pre-conceptions were that students would be less keen on engaging with staff via social media. However, the survey results showed only 14% of students against this. Using machine learning to investigate whether those for academic SMN use (dubbed "integrationists") could be separated from those against ("separatists") showed it was hard to predict students' attitudes purely based on their patterns of use of SMN. The complexity of the issues is reflected by focus group work that identified SMN as just one part of a complex pattern of personal communication. For some, Facebook (FB) consumed more time compared to text/email, but the latter were seen as more privileged with use restricted to higher value conversations and participants. Other insights included conflicted views on the value of SMN, a functional view of SMN alerts, and the lack of immersion in academic SMNs. These results suggest SMN are not a panacea for student engagement. Care must be taken in designing effective learning conversations using appropriate media and interaction. Slavishly adopting social practices from SMN will not automatically benefit learners and may leave them more disengaged and distracted than ever.

**Keywords:** social media networks, student engagement, academic engagement

## 1. Introduction

The outstanding technological phenomena of the past decade has been the largely unforeseen and unexpected growth in the use of technology for social interaction through Social media networks (SMNs). In just ten years the world has seen the introduction and spread of what is now considered to be the primary mode for social interaction, Facebook. From its early developmental stages in East Coast universities in the USA, Facebook spread across the Atlantic Ocean into Europe and across the world. Globally there are now, in 2016, in the region of 1.65 billion Facebook users accessing the website at least once per month, (Zephoria, 2016). A 2014 Ofcom report notes that Facebook remains the default social networking site for 96% of UK adults who are online (OfCom, 2014). Smartphone ownership has also grown dramatically in this period of time since the first iPhone™ was introduced by Apple™ in 2007 and revolutionised internet access. This is reflected in the nearly 1 billion users now accessing Facebook (FB) via their phone (eMarketer, June 2016).

Social media networks (SMNs) have enabled millions of ordinary people to interact instantly electronically and to share their lives more easily than before portable computing technology arrived (Lenhart et al, 2010). Since 2007 a wired connection to the internet has no longer been essential in order to access social media or websites online. The development of smartphones and portable tablets with fast Wi-Fi access and touchscreens led to the rapid introduction of mini applications (Apps). These have further driven the growth of SMN for online, social interaction. Since 2010 we have seen worldwide development and growth of different social media networks such as Twitter, Snapchat and Instagram for sharing photos and third generation mobile messaging networks such as WhatsApp and WeChat.

### 1.1 Developing engagement with social media

Our longitudinal research among university undergraduates has been undertaken against this whirlwind of change. It is this generation, and their younger siblings currently progressing through primary and secondary education, which increasingly cannot remember a time before social media was a normal part of their everyday life. However, the research group was interested to know how far the students in the course of their studies wanted to engage with SMNs across the staff/student divide. It is an area that has engaged a number of academic investigations over the past 10 years, see for example Corrin and colleagues' work (2010). While Facebook is now ubiquitous in higher education for both staff and students (Dyson, Vickers, Turtle, Cowan, & Tassone 2015) the authors have also examined a range of social networks in use by students to survey their popularity and relevance to study needs.

Our students in HE are increasingly referred to as a type of 'digital native' in popular media .While the description of 'digital natives' has become a popular way of describing the so-called millennial generation who have never experienced life without digital, this is a much-contested area. Challenging Prensky's (2001) assertion of a divide separating 'digital natives from digital residents', academics have sought to develop a more nuanced approach which considers multiple approaches that students make in the appropriation of the technologies they use to support their studies. The authors of this paper prefer the descriptions proposed by White and Le Cornu (2011) of 'digital residents' and 'digital visitors', whereby the different digital experiences of a population are described along a continuum between 'visitor and resident' instead of as a strict 'either/or' choice of which the digital natives/immigrants title allocates according to demographics. Corrin et al in an earlier study articulated a similar point in seeking:

> *'A more in-depth investigation of the technology practices of these 'digital natives' to understand how technology is transforming their social and academic lives and, importantly, how they are shaping technology to suit their lives.' This is needed because '… the homogeneity of this generation cannot be assumed and that in reality the technological characteristics of the digital natives are significantly diverse in nature, especially in relation to technology use as part of students' academic study.' (Corrin, Bennett & Lockyer, 2010).*

By way of demographic background the current situation is of a study across male and female student cohorts following undergraduate programmes in Computing (including both Computer Science and IT), Education and Business in a medium-sized Post-92 university with c.25,000 full time equivalent students in South-East England. There is a well-developed VLE and a strong commitment across the university to developing digital resources for all its students. Investment in hardware and software has supported the blended learning philosophy of the university for over ten years and in addition there are several undergraduate programmes which run online and support students located around the world.

### 1.2 Approach used and methodology

A mixed-methods approach was used and full ethical approval was sought and agreed prior to the start of the study. The primary means of gathering student opinion was through a survey which was presented to students in a face-to-face lecture context by one of the research team. Participation was of course voluntary and the questionnaires were gathered in from participants after a short period of time. This personal approach allowed for a high degree of participation overall.

To gather qualitative feedback from participants, volunteers were invited to participate in a focus group where the issue of SMNs was considered. A series of focus groups (n=3) was held in a study room in the University's learning resource centre. Attendance at each was 4-5 students. The participants were chosen from among the volunteers to include a mix of age, gender and ethnicity which as far as possible would reflect the demographics of the main survey participants. The focus groups were recorded and the analysis was undertaken by two of the researchers listening to the recordings and transcribing the key points according to the themes of the questions. The survey results are presented below followed by the analysis using machine learning techniques and then the focus group analysis.

## 2. Survey results on social media use

The survey data presented in this section is a continuation of the survey described in [Saward et al 2012] which has been administered to both staff and students [Saward, 2012]. Since this first phase of work the same survey has been administered to eleven different student cohorts in three subsequent phases with the number of respondents summarised by subject area below. It provides an important back drop to the question of how students may wish to use SMN as part of their studies. As with earlier instances of the survey, the questions are focused on three main types of information:

- general use of social networks in terms of services and devices used;
- current use of social networks and/or the VLE for communication about studies;
- attitude towards using a social network to receive updates from the VLE about academic issues.

The variety of students surveyed supports analysis of students' use of and attitudes towards social media, depending upon changing use of social media over time and subject of study. Temporal effects include changes that have occurred in SMN technology and environment over the past four years of the project; and the time spent in the HE environment by students. These two issues are considered separately as general developments in social networks over time appears to be more significant than level of study, which in turn is less significant than the subject of study.

**Table 1:** Respondent cohorts

| Subject \ Phase | I | II | III | IV | Total |
|---|---|---|---|---|---|
| Business | | 46 | | | 46 |
| Computer Science | 101 | 225 | 60 | 171 | 557 |
| Education | | 114 | 7 | | 121 |
| Physics, Astro & Maths | 81 | | | | 81 |
| Staff | 49 | | | | 49 |
| **Total** | **231** | **385** | **67** | **171** | **854** |

## 2.1 Effect of time on social network environment

Analysing computing students (CS and IT students within the school of Computer Science) covers five hundred students in the four survey phases, generating six pair-wise comparisons between phases. Looking at service and device usage there are few significant differences between adjacent phases. However, comparing survey phases with larger two or three year gaps shows significant differences. In particular, comparing the services used between Phase I and Phase IV as shown in Table 2a:

- Facebook shows a significant decline from first to last phase, with the rate of decline more significant in the first three phases and slowing down between phases II and IV
- Google+ shows significant decline from first phase to last, with an against trend rise in Phase III
- The use of other services shows a significant increase, with an against trend dip in phases II

**Table 2:** Service and devices compared across survey phases

| Social Networks Accessed<br>Phase | Average frequency of use<br>I | <br>IV |
|---|---|---|
| Facebook | **4.2** | **3.8** |
| Twitter | 2.5 | 2.4 |
| Google+ | **2.1** | **1.6** |
| Yahoo Answers | 1.5 | 1.6 |
| Other Service | **1.6** | **1.9** |

**(a)** SMN services

| Device used for Social Network Access<br>Phase | Average frequency of use<br>I | <br>IV |
|---|---|---|
| Desktop | **3.1** | **2.3** |
| Laptop | **3.9** | **3.6** |
| Tablet | **1.7** | **2.5** |
| Smartphone | **3.9** | **4.4** |
| Other Device | 1.1 | 1.0 |

**(b)** Devices used

The statistical differences between the different phases was undertaken using a two-sided t-test at 5% significance on the average frequency of use where 5 represents very frequent use (more than once a day), 4 means frequent use (i.e. once a day) and 1 shows no use. The significant results are indicated by the shading and bold text in Table 2a above. As for the overall usage of SMN, this is discussed in section 3 below. Device use trends for SMN access appear more consistent and significant as shown in Table 2b. Newer form factors, i.e. smart phones and tablets, show a consistent significant increase in use between phases I and IV with a corresponding decrease for more traditional devices (laptops and desktops). Despite these changes, relative usage remains similar with smart phones and laptops being the preferred.

## 2.2 Effect of subject on social media use

Phase II allows comparison between groups of students at an equivalent level of study but who are studying different subjects. These second year undergraduate students included 113 studying in the School of Education and 143 computing students, split between IT (72) and Computer Science (81).

Table 3 shows statistically significant differences between the two different groups of students, using a 5% two-sided t-test indicated by the shading and bold text. This shows computing students' higher Yahoo Answers and other social networks use compared to Education students. In contrast, Education students used Facebook more although this difference was just outside the 5% significance test.

**Table 3:** SMNs used and compared across student cohorts

| Social Networks Accessed | Service users | | % participants using service | | Average frequency of use | |
|---|---|---|---|---|---|---|
| School | Ed | CS/IT | Ed | CS/IT | Ed | CS/IT |
| Facebook | 108 | 143 | 95% | 93% | **4.3** | **4.1** |
| Twitter | 62 | 94 | 54% | 61% | 2.6 | 2.8 |
| Google+ | 39 | 57 | 34% | 37% | 2.1 | 1.8 |
| Yahoo Answers | 38 | 65 | 33% | 42% | **1.5** | **1.7** |
| Other Service | 2 | 23 | 2% | 15% | **1.2** | **1.5** |

**Table 4:** Devices used and compared across student cohorts

| Devices use for Social Network Access | Device users | | % participants using device | | Average frequency of use | |
|---|---|---|---|---|---|---|
| Programme | CS | IT | CS | IT | CS | IT |
| Desktop | 53 | 36 | 65% | 50% | 2.9 | 2.3 |
| Laptop | 69 | 65 | 85% | 90% | 3.9 | 4.0 |
| Tablet | 26 | 36 | 32% | 50% | 1.8 | 2.6 |
| Smartphone | 69 | 65 | 85% | 90% | 3.9 | 4.2 |
| Other Device | 5 | 0 | 6% | 0% | 1.1 | 1.0 |

Further analysis show significant differences between IT and CS students themselves. While Education students' average use (at 2.6) is marginally above CS students (at 2.5) but significantly lower than the IT students (at 3.1). Significant difference can also be seen between CS and IT students in their use of devices, as shown below in Table 5 with Education students closer to IT in desktop use (1.9) and IT with tablets (1.7). The importance of these results is in the variance that can be found both between Faculties, or even different programmes within the same discipline, not the details of third or fourth choice of device.

### 2.3 Effect of level – time spent in higher education

Broadly speaking, students enter higher education as undergraduates at level 4 and complete their studies at level 6. The level is therefore a proxy for the amount of time spent in HE. This information was analysed for computing students, looking for differences in SMN use by level to see if patterns of use changed. This analysis showed that subject differences within the computing field were more important than level differences. For example,

- In Phase II, level 5 computer science students were more like level 4 computing students in their lower use of Twitter and other service, and a preference for desktops over tablets, compared to IT students at level 5;
- In Phase IV, level 6 strategic information systems students were more like level 4 computing students, and less like level 6 web application development students who were more frequent users of Facebook.

## 3. Effect of SMN Engagement on students' desire for academic use of SMN

Our simple survey highlights the environmental complexity in which students are living and using SMN. Despite this, three clear exemplars, personas or stereotypes are frequently encountered:

- frequent users of SMN who are keen to use it as part of their studies
- frequent users who wish to keep academic interaction separate from other uses of SMN
- students who refuse to use SMN at all, for studies or other purposes

We previously labelled these types *integrationists*, *separatists* and *refuseniks* with *agnostics* being undecided about academic use of SMN [Saward, 2011]. Given these exemplars, how general use of SMN affects students' desire to use it in their studies is a key question. In particular, we are interested in how attitudes on getting VLE updates via SMN, thereby bringing personal and academic online activities closer together.

### 3.1 Dependency analysis

The relationship between SMN use and desire for VLE/SMN integration is seen in the maximum SMN frequency plotted against integration desire which defined the original integrationist / separatist / refusenik typology as shown in Figure 2.

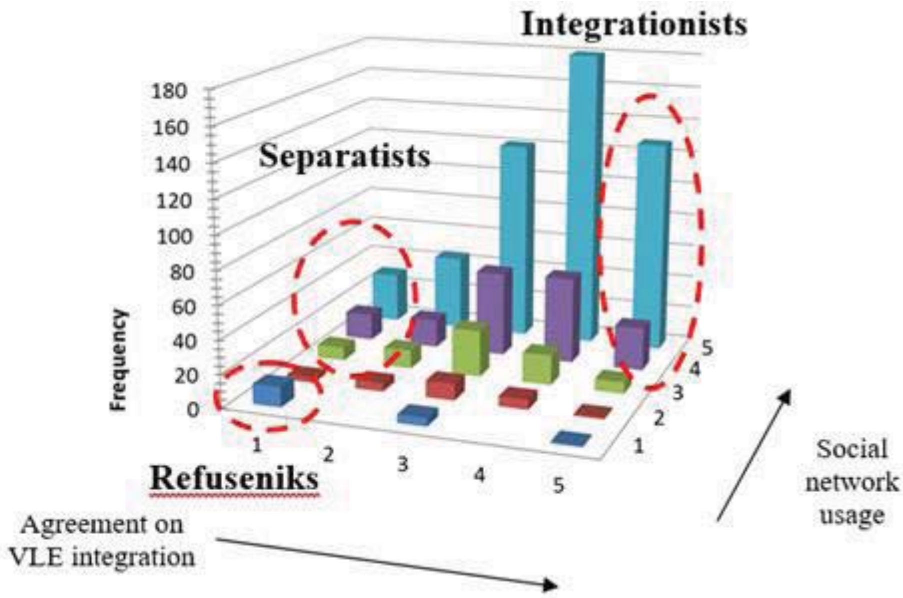



**Figure 1:** Social media network usage against integration desire for all students for Phases I-IV

Residual analysis of all the student respondents shows significant differences in the chi-squared components (shown in table 5b) between observed data (as shown in table 5a) and the expected distribution if these two factors were independent. The total chi-squared value of 114 is significant at a less than 0.01% chance. The key variation is in refuseniks (SMN usage=1 and integration=1) and the most positive integrationists (usage=5, integration=5). Separatists (usage=5, integration=1) are fewer than expected if usage were independent of integration attitude. This difference for separatists, with a calculated adjusted residual of 3.83, can be interpreted as statistically significant in a 5x5 table with 16 degrees of freedom.

| SM / VLE updates | Max SM Usage 1 | 2 | 3 | 4 | 5 | total Σ |
|---|---|---|---|---|---|---|
| **1** | 12 | 3 | 8 | 16 | 30 | 69 |
| **2** | | 5 | 11 | 17 | 45 | 78 |
| **3** | 5 | 10 | 28 | 51 | 121 | 215 |
| **4** | | 6 | 18 | 52 | 180 | 256 |
| **5** | 1 | 1 | 7 | 26 | 128 | 163 |
| total Σ | 18 | 25 | 72 | 162 | 504 | 781 |

**(a)** Observed distribution

| SM / VLE updates | Max SM Usage 1 | 2 | 3 | 4 | 5 | total Σ |
|---|---|---|---|---|---|---|
| **1** | 68.14 | 0.28 | 0.42 | 0.20 | 4.74 | 73.8 |
| **2** | 1.80 | 2.51 | 2.02 | 0.04 | 0.57 | 6.9 |
| **3** | 0.00 | 1.41 | 3.38 | 0.92 | 2.27 | 8.0 |
| **4** | 5.90 | 0.59 | 1.33 | 0.02 | 1.33 | 9.2 |
| **5** | 2.02 | 3.41 | 4.29 | 1.80 | 4.95 | 16.5 |
| total Σ | 77.9 | 8.2 | 11.4 | 3.0 | 13.8 | **114.3** |

**(b)** Chi-squared values

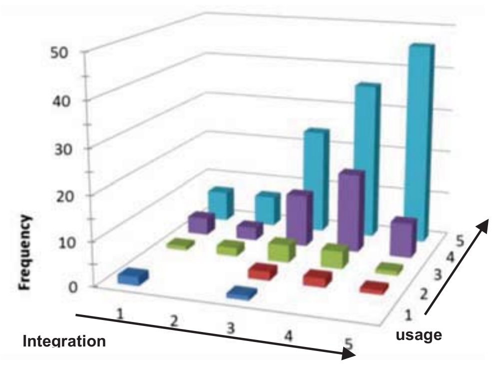
**Tables 5:** Analysis of social media network usage against integration desire

Calculating adjusted residuals in the same way for the integrationists and refuseniks produce statistically significant results of 4.20 and 8.75 respectively. This analysis suggests that the desire for social media integration with the VLE is dependent on the usage of social media.

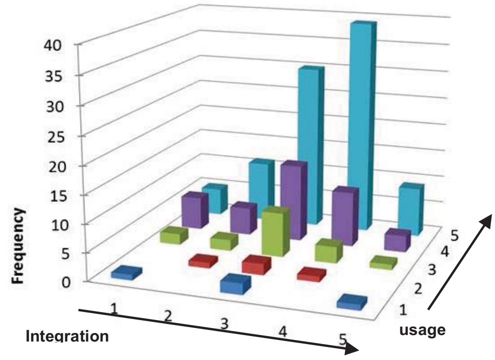
### 3.2 Differences between survey phases

The SMN environment has been changing between different phases of our work as discussed in section 2.1. For example, Phase IV computing students make less use of Facebook, with this decline partially offset by increasing use of other services. Similarly, changes can be seen over time in the total usage of SMN. The total reported hours of use has gone down slightly from 18.6 in Phase I to 18.1 hours a week in Phase IV, although the number of accesses has remained almost constant. While neither difference is statistically significant, change in student maximum frequency of use of any service is significant. This declines from 4.6 for Phase I students to 4.4 for Phase IV students. The lower level of use by Phase IV is seen alongside a lower desire to receive VLE updates via

SMN. The Phase I average was 3.8, while Phase IV students averaged 3.2 - on a scale of 1 (strongly disagree to having VLE updates via SMN) to 5 (strongly agree). This shift is seen in changes in the back, right hand corner between figures 2a and 2b.




**(a)** Phase I




**(b)** Phase IV

**Figure 2:** Social media network usage against SMN/VLE integration desire over time

Changes in SMN usage are reflected in chi-squared scores. Phase I shows clear dependencies with a statistically significant overall result of 30.3. However, this dependency between usage and integration desire is not seen in the latest phase where residual analysis does not highlight significant dependencies. This suggests that while current students are generally more positive than negative about integration of social media with the VLE, this view is not driven by their use of social media.

| SM / VLE | Max SM Usage | | | | | |
|---|---|---|---|---|---|---|
| updates | **1** | **2** | **3** | **4** | **5** | total Σ |
| **1** | 13.75 | 0.38 | 0.01 | 0.13 | 0.50 | 14.8 |
| **2** | 0.20 | 0.33 | 1.89 | 0.01 | 0.09 | 2.5 |
| **3** | 0.13 | 0.59 | 0.51 | 0.29 | 0.58 | 2.1 |
| **4** | 0.98 | 0.08 | 0.00 | 0.93 | 0.25 | 2.2 |
| **5** | 0.90 | 0.16 | 1.87 | 2.88 | 2.86 | 8.7 |
| total Σ | 16.0 | 1.5 | 4.3 | 4.2 | 4.3 | **30.3** |

**(a)** Phase I

| SM / VLE | Max SM Usage | | | | | |
|---|---|---|---|---|---|---|
| updates | **1** | **2** | **3** | **4** | **5** | total Σ |
| **1** | 1.14 | 0.36 | 0.22 | 1.97 | 1.40 | 5.1 |
| **2** | 0.49 | 0.54 | 0.00 | 0.03 | 0.02 | 1.1 |
| **3** | 0.22 | 0.22 | 0.89 | 0.01 | 0.42 | 1.8 |
| **4** | 1.36 | 0.09 | 1.09 | 0.66 | 1.56 | 4.8 |
| **5** | 1.14 | 0.36 | 0.13 | 0.05 | 0.04 | 1.7 |
| total Σ | 4.4 | 1.6 | 2.3 | 2.7 | 3.4 | **14.4** |

**(b)** Phase IV

**Tables 6:** Chi-squared analysis of SMN usage against integration desire over time

## 4. Machine learning

The chi-squared analysis provides some support for the idea that personal use of SMN would pre-dispose individuals to be receptive about their academic use. However, the growing number of people in Phase IV who are not positive about this development, combined with the increasing complexity of the SMN environment raises the challenge of trying to predict which groups of students would engage with academic use of SMN. As a first step in trying to mine the survey data we undertook two basic experiments using:

- classification to identify rules that might be used to assign a type to each respondent
- simple clustering to group respondents to identify common, defining characteristics of SMN use

The primary aim of these experiments was to investigate the explanatory nature of models built on the raw survey data, and to see if they could generate insight into what might distinguish an integrationist from a separatist. At this point in time, refusenik students who made no use of social media were removed, as they could easily be identified by their lack of engagement with SMN. In terms of the data used, survey data was entered into an Excel spreadsheet, then exported as a CSV for import into Weka, a well-established tool for machine learning [Witten et al, 2011].

### 4.1 Classification rules

The first machine learning experiment uses the classification algorithm J48 [Witten et al, 2011] to identify explicit rules to define individuals as integrationists, separatists or agnostics. A simple pair of generated rules can be seen in Figure 3.

```
smNetwork = 2+
|  Facebook <= 2: un (6.25/2.24)
|  Facebook > 2: +ve (49.56/12.37)
```

**Figure 3:** Simple decision tree rules learnt from survey data

The two rules in Figure 3 apply if a student gives two or more (shown by the **2+**) preferred SNMs to receive VLE updates. If their relative frequency of use of Facebook was once a month or less (**<= 2**) then they would be classified as an agnostic or **un**decided. However, if their Facbook use was higher than this (**>2**), they would be classified as positive (**+ve**) about SMN/VLE integration.

There are two key factors in judging the success of the decision tree. The first is the information that can be derived from the rules produced. In the case of Figure 3, the insight is relatively easy – users of multiple SMN which include Facebook are likely to be integrationists. However, the pruned decision tree output contains 62 rules with 118 decision points.

```
smNetwork = t
|  Smartphone > 2: +ve (97.42/35.73)
|  Smartphone <= 2
|  |  snContact > 2.5: un (7.81/2.87)
|  |  snContact <= 2.5
|  |  |  Laptop <= 2: -ve (4.14/0.82)
|  |  |  Laptop > 2: +ve (4.83/2.26)
```

**Figure 4:** Decision tree rules for VLE updates via Twitter

Making sense of this can be more difficult as rules become more complex although rules for whether students preferring updates via Twitter (**smNetwork = t**) are pro, anti or undecided about integration are still manageable as shown in Figure 4. In other cases, the rules become even more complex and less actionable as they attempt to differentiate integrationists from separatists. For example, rules for students without a preferred SMN for updates are more numerous (up from 4 in the case of those preferring Twitter to 13), complex (up from 7 decision points to 25) and use more types of data (up from 4 to 12).

## 4.2 Separating positive and negative attitudes to SMN integration

The second key issue in judging decision tree success, after complexity, is the accuracy of the rules. This is shown by the numbers in brackets following the rules given in Figures 3 and 4. The first number given at the end of each rule shows the number of instances to which this rule applies. The second shows the number who are incorrectly classified by this rule with decimal/fractional figures being generated by individuals with incomplete data. For example, the rules in Figure 3 apply to approximately 47 surveyed individuals of which 37 are successfully classified as integrationists (**+ve:** 49.56 - 12.37) and 4 are agnostic (**un:** 6.25 - 2.24). Overall, the decision tree generated from the data correctly classifies 56% of the surveyed individuals, based on ten-fold cross validation as shown by the overall recall in Table 7a. The cross validation is used to randomly select a test set used in generating the decision tree. The resulting set of rules is then tested on the remainder of the data.

**Tables 7:** Decision tree performance

| Class | | Recall | Precision |
|---|---|---|---|
| +ve | integrationist | 0.814 | 0.659 |
| un | agnostic | 0.291 | 0.371 |
| -ve | separatist | 0.241 | 0.385 |
| **total weighted average** | | **0.564** | **0.529** |

**(a)** Detailed accuracy by class

| Reported Class | J48 classification | | | |
|---|---|---|---|---|
| | +ve | un | -ve | total |
| +ve | 351 | 63 | 17 | **431** |
| un | 119 | 65 | 39 | **223** |
| -ve | 63 | 47 | 35 | **145** |
| Total | **533** | **175** | **91** | **799** |

**(b)** Confusion matrix

The effectiveness of the rules in the decision tree for separating integrationists from separatists can be seen in Table 7a. Looking at the recall, the rules are good at identifying integrationists, with 81.4% (351 of 431) of those having given a response that identifies them as integrationists (**smUpdate >3**) being correctly labelled by the J48 algorithm as such. The precision is less good with the integrationist label (**+ve**) being applied to incorrectly to

34% (182 of 533) of the survey population who actually identified as separatists (**-ve**) or agnostics (**un**). This misclassification can be seen in the confusion matrix in Table 7b. The rules for identifying those undecided or against SMN integration with the VLE are much less successful. The recall is much lower meaning that only 29% of agnostics and 25% of separatists are correctly labelled as such by the decision tree.

The results of the rules produced in the decision tree shows that it is possible to identify characteristics that make people integrationists, but there are very similar individuals who have a different attitude to getting VLE updates via SMN. To test this conclusion, simple k-means was used to get a better understanding of the similarities between respondants, dividing them into two separate clusters. This approach gives a simple insight into the similarities between respondents as shown in Table 8.

**Table 8:** K-means cluster comparison

| | total | cluster 1 | cluster 2 | difference | type |
|---|---|---|---|---|---|
| Smartphone | 4.0 | 4.8 | 3.5 | 1.4 | device |
| Facebook | 4.1 | 4.4 | 3.9 | 0.5 | service |
| Laptop | 3.9 | 4.3 | 3.6 | 0.7 | device |
| Twitter | 2.5 | 4.0 | 1.4 | 2.6 | service |

These results show cluster 1 more engaged with social media generally, but in particular much more frequent users of smartphones and Twitter, as well as having higher usage of laptops and Facebook. However, these two naturally defined clusters do not easily map into the integrationist / separatist split. Integrationists split almost equally between the two clusters, while non-integrationists are split one third / two thirds between clusters 1 and 2. The resulting overall accuracy is only 45%, again showing the difficulty of using the survey data of student behaviour to identify their attitudes to using SMN for academic purposes.

## 5. Focus group analysis

The focus groups provided more in-depth way of exploring issues around academic use of SMN. Brief analysis here is separated out according to the students' answers to the questions asked and reported from students across the focus groups.

### 5.1 Focus group questions

The focus groups used a series of questions, grouped around three themes to provide structure to the sessions which were typically 30 minutes long. The themes included:

- general questions on how and why SMN is used, and balancing study and other parts of life
- social media and how it might be used for studying
- communication outside of social media

#### *5.1.1 Q1: How does social media fit in with your life?*

Most of the undergraduate students were enthusiastic users of a limited set of SMNs, which they swapped around constantly during their study time. They said their predominant use was of FB and lower levels of Twitter use were reported echoing the survey results. The following comments show the range of responses indicative of both integrationists and refuseniks.

> *'… [FB] fits in with everything, it is everywhere- I am constantly using it, such as setting Events pages for birthdays'*
>
> *'I don't use FB at all as I am not a fan of social media'*

#### *5.1.2 Q2: What about receiving information from academic staff through Facebook?*

This question generated a definite assertion that students want to be able to control the amount that lecturers can see of their use of Facebook and set clearly defined limits about access to what they deemed to be their private space for study and sharing with friends and contacts outside the university. This shows students seeking a clear separation between their private space and their shared study spaces and taking on a "separatist" persona.

*'I prefer StudyNet [the university's VLE] and email for studying. I prefer [to make] a distinction between study and social life'*

*'I use FB more than StudyNet for group work. I don't want my tutors seeing or influencing my work'*

*5.1.3 Q3: Would you like alerts sent to you via FB?*

Here the students in the focus groups were specific about what they did and did not want from linking SMN to the VLE. They did not want to share personal details, preferring to be able to control who saw what and the setting up of alerts:

*'Perhaps linking deadlines to my FB calendar would be acceptable'*

*'I don't want direct messaging from lecturers on FB. I only use email to contact staff'*

### 5.2 A hierarchy of SMN use

Participants also completed the standard survey to compare views expressed during the focus group with data derived from the analysis shown above. This validated the quotes above which appear indicative of separatist attitudes to SMN and study, keeping academic use away from personal interaction. This attitude is reflected in participants' survey responses which show would classify 50% as separatists, compared to the overall survey response of 17% (from Table 5). However, the views below show a more nuanced approach that fits with the inhabitant/visitor distinction. Technology is being used in different ways at different times to support different goals.

*'I use FB a lot for work. I use Twitter too. FB is linked to my phone, Twitter is more open so I would not put private stuff there. FB is my 1st choice for social media.'*

*'FB helps me to plan my week with Group project meetings as it's quicker than texting the whole group. We usually set up separate groups for each assignment. It's much faster than using StudyNet [the VLE]'*

*'I tend to have FB open on a tab on my laptop when I am in the library and dip in when I get an alert'*

A recent survey reports changing teenage (Pew,2012) with 64% of teachers asserting that: '…t*oday's digital technologies "do more to distract students than to help them academically."'* Our own research supports this as our students freely admit to trying to multi-task on their studies by always having their social networks available.

## 6. Conclusions

Tess's asks (2013) why there were so few studies on the use of social media in HE, asking:

*'Is social media an efficient and effective software solution for the higher education classroom? … Certainly social media has been prevalent on the college campus, but not until recently has its viability as a learning medium been considered by a growing number of educators.'*

Our study shows many of our 'digitally savvy' students will happily multi-task using their SMNs alongside their studies choosing when, where, what and how to access media according to personal preferences. The clear message from these cohorts is that while they are happy to see academic use of SMN they want to maintain control over access and choose what information to draw to themselves.

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# Computer Assisted Versus Traditional Testing: Statistical Assessment of Students' Performance in Different Types of Tests

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**Abstract**: Computer technologies have opened up new possibilities for optimizing the administration of tests, test development and assessment. Computer Aided/Assisted Testing, as well as Computer Assisted Language Testing, have brought many positive aspects that can be applied in order to create a more positive attitude toward test assessment, to reduce item exposure and subsequent security risks, and provide a valid and reliable measurement of students' competence. Nowadays, teachers have a choice between supervised or unsupervised e-tests, and quite often they vote for unsupervised tests as these tests allow frequent testing of many students with fewer teaching staff, and give each student the significant freedom of choosing the time, place and manner in which to take the test. Teachers who prefer classical methods of teaching insist on paper-and-pen tests. The authors describe their experience with all of the above mentioned types of tests, and then focus on their research dealing with long-term observation of students' results and statistical assessment of their performance in English language. In this article, students' results of e-test tests and paper-and-pen tests (supervised and unsupervised) are compared in order to find any relationships among them, and to find an optimal proportion among various types of tests. Applied statistics have been applied to gain valid data when analysing different types of tests and comparing the results of these tests. Parametric and non-parametric statistical tests of the hypothesis regarding these relationships are described in the last part of this article.

**Keywords:** computer assisted testing, supervised and unsupervised e-tests, paper-and-pencil tests, applied statistics, statistical tests

## 1. Introduction

Information and communication technologies have become widespread all around the world. Moreover, in the field of language testing they have been instrumental in leading to innovation in language testing. As a result, students can take computerized tests such as CBT (Computer Based Test), CBELT (Computer Based English Language Test), CAT (Computer Aided/Assisted or Computer Adaptive Test), CALT (Computer Adaptive Language Testing), which can be used for testing purposes (Bennett, 2002; Pommerich, 2004; Cechova, 2014; Rezaie and Golshan, 2015).

Today, computer technologies in the field of language learning, teaching, assessment, and testing, have become so widespread that they are regarded as an inseparable part of the education system at basic and secondary schools and universities. José Noijons says that "CALT is "an integrated procedure in which language performance is elicited and assessed with the help of a computer". In its purest form, three integrated procedures can be distinguished which relate to the following processes: generating the test, interaction with candidate, and evaluation and responses (Noijons, 1994). Laghos defines CALT as "an integrated procedure in which language performance is elicited and assessed with the help of a computer" (Laghos, 2009). Chapelle writes about three main motives for using technology in language testing: efficiency, equivalence, and innovation. Efficiency is achieved through computer-adaptive testing and analysis-based assessment that utilizes Automated Writing Evaluation (AWE) or Automated Speech Evaluation (ASE) systems. Equivalence refers to research on making computerized tests equivalent to the paper and pencil tests which are considered to be "the gold standard" in language testing. Innovation—where technology can create a true transformation of language testing—is revealed in the reconceptualization of the L2 ability construct in CALT as "the ability to select and deploy appropriate language through the technologies that are appropriate for a situation" (Chapelle & Douglas, 2006).

The nature of CALT has many positive aspects. According to Pathan the use of computer technology in the field of language assessment and testing falls under three major domains due to the nature of use of this technology. These include:

- use of computer for generating tests automatically;
- interaction of computer with the candidate (in the form of online interaction);

- use of computer for the evaluation of test taker's responses (Pathan, 2012).

The advantages of CALT are well known and apparent. Pathan has mentioned the following: overcoming administrative and logistic burdens, consistency and uniformity, better authenticity and greater interaction, self-pacing, more positive attitude toward tests, individualized testing environments (Pathan, 2012). CALT also helps test developers to set the same test conditions for all participants, as well as to improve all aspects of test security by storing questions and responses in databases, and enables testers to create randomized questions and answers from vast question databanks. The use of CALT also decreases the amount of time needed for test preparation and marking and enables to track a student´s behaviour (e.g. time spent on one test item or section, corrections made, etc.).

On the other hand, many researchers (Canale 1986, Lange 1990; Tung 1986, Alderson, 2000) have shown the limitations and pitfalls of the use of CALT in the field of language assessment/testing. Alderson emphasizes that examinees need computer literacy in order to eliminate the mode effect on computer-based testing (Alderson, 2000). According to other language test specialists, CALT requires for example, equipped computer labs, a large bank of test items, and all test items must measure the same single trait. Moreover, open ended questions are not usually presented in computerized formats because these kinds of questions are usually scored by teachers.

Students especially appreciate the lack of time limits and being able to work without supervision of testers or teachers, which can be stressful. They can be given as much time as they need to finish a test, and unsupervised tests allow students to work at their own pace, to choose time and place (i.e. a less formal environment) within the test limit. Teachers emphasize easy test distribution without the necessity to copy hundreds of papers and especially easy assessment, without hours spent on marking tests.

## 2. Computer assisted testing versus traditional testing

One of the first debates concerning the equivalence of CALT (e-testing) and traditional testing (pen and paper-based tests) was published in 1992 by Dillon, who wrote a critical review of the empirical literature on reading from paper versus screen. According to Dillon´s outcomes it is not possible "to achieve total equivalence" between them (Dillon, 1992). Dillon wrote that reading was some 20 to 30% slower (in terms of proof-reading performance) from a computer screen than from paper (Dillon, 1994). Noyes and Garland in their study confirm that early studies focusing on comparisons of computer- and paper-based tasks generally favoured paper for better performance according to the metrics of speed, accuracy and comprehension (Noyes, Garland, 2008). How students perform on computer-delivered tests depends, in part, on how familiar they are with the technology, concludes a set of studies conducted by Princeton, N.J. Results showed that average scores on computer-based writing tests generally were not significantly different from average scores on paper-based exams. But, as with math tests, individual students with better hands-on computer skills tended to achieve higher online scores, after adjusting for their level of paper writing skills (Olson). Karadeniz studied the impact of paper based, web based, and mobile based assessment on students' achievement. In his study he proves that students had positive attitudes towards web based and mobile based assessment due to ease of use, and comprehensive and instant feedback. Moreover, the most favoured tests were web based, and the least favoured were paper based (Karadeniz, 2009).

## 3. English language at the University of Defence

Knowledge of foreign languages helps reduce language barriers and is essential for increasing individuals´ mobility both in their personal and professional lives. It is one of the reasons the University of Defence (UoD) emphasizes studying foreign languages, especially English language. Another reason is that the Czech Army belongs to the NATO structures. English is undoubtedly a priority as it is a mandatory subject for all students at the UoD. However, all students have to study two foreign languages. In addition to the obligatory English, they can choose German as a second language. Language education at the UoD respects the standard of NATO STANAG 6001.

NATO STANAG (Standardisation Agreement), is an international military standard created by the North Atlantic Treaty Organisation (NATO) for regulating equipment, procedures, tactics, training and just about everything affecting the way armed forces from different countries work together on operations and exercises. STANAG 6001 is a language proficiency scale designed to allow comparisons of language ability in different countries. The scale consists of a set of descriptors with proficiency skills broken down into six levels/SLP (Standardized Language Profile). They are defined as follows:

- Level 0: No proficiency
- Level 1: Survival
- Level 2: Functional
- Level 3: Professional
- Level 4: Expert
- Level 5. Highly-articulate native.

Each level category contains tests from all four skills, always in the same order as they appear on STANAG language certificates: Listening Comprehension, Speaking, Reading Comprehension, and Writing. UoD students must pass Stanag SLP 2222 by the end of the fifth semester.

UoD students are obliged to pass NATO STANA 6001 SLP 2222 by the end of the fifth semester but the number of English lessons is limited by accredited study programmes, and this number is not very high. This is one reason why teachers are trying to replace pen-and-paper tests with e-tests, and even in some cases unsupervised e-tests. Unsupervised tests were chosen in order to save time for regular face to face lessons. Unsupervised tests enable teachers easier, but nevertheless safe, distribution of tests, and immediate assessment and feedback.

At the beginning of the first semester all students are tested in order to create homogeneous, groups so that students of similar levels of are placed together, working on materials suited to their particular level. Placement tests are carried out in the form of unsupervised e-tests, because it is necessary to assess a large number of students and to provide accurate and fast results to both the examinees and the teachers. However, in some groups there were still students with different levels of English, so the authors decided:

- to repeat a placement unsupervised test (same structure of an e-test with different items);
- to prove test results by supervised pen-and-paper test.

The authors objective was to find out if all test results can be comparable, and if the tests measure what they are supposed to measure. The authors compared test results of all military students who study at the Faculty of Military Leadership (FML) and the Faculty of Military Technologies (FMT) in a new study programme. So far only data of the first and the second grade are available, as this study programme started in September 2014. A further objective was to look at how students performed when given English language tests using paper-and-pencil versus computer.

## 4. Placement analysis

The data have been collected from September 2014 to January 2016. Exploratory statistics was the basis of our survey. The authors used data gathered from two academic years, 2014/2015 and 2015/216. Altogether, test results of 314 students were analysed:

- academic year 2014/2015 altogether 146 students, 84 students from FML and 62 students who studied at FMT.
- academic year 2015/2016 altogether 168 students, 104 from FML and 64 who studied at FMT.

### 4.1 Basic features of statistical data

Basic features of the variables are expressed in the following table (Table 1) that describe numeric characteristics of the data file. Test T1 was unsupervised e-tests which were taken at the beginning of the first semester, test T2 was unsupervised e-tests which were taken at the end of the first semester. A test (T/S) was supervised pen-and-paper test, whose aim was to prove or reject the relevance of tests T1 and T2. The students took the T/S test at the beginning of the third semester. The first number in the table indicates the year of study (1 is the first year, 2 the second year).

If we look at the data characteristics in detail, it is obvious that basic indicators (number of observations N, mean, median, minimum, maximum, lower and upper quartile, standard deviation, skewness, kurtosis, See Table 1) show statistical differences between FML and FMT. These differences are more apparent from the Box and Whisker Plot (Figure 1). The Figure expresses the basic features of position and variability of the analysed variables.

**Table 1**: Descriptive characteristics

| | N | Mean | Median | Min | Max | LowerQ | UpperQ | Std.Dev. | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|---|---|
| 1FML_T1 | 103 | 62,87 | 63 | 23 | 90 | 55 | 73 | 12,72151 | -0,384596 | 0,42963 |
| 1FML_T2 | 103 | 64,19 | 65 | | 95 | 53 | 73 | 14,72763 | 0,017657 | -0,556729 |
| 1FML_T/S | 97 | 63,15 | 63 | 38 | 95 | 53 | 73 | 13,37468 | 0,525723 | -0,286875 |
| 1FMT_T1 | 62 | 64,18 | 63 | 18 | 95 | 55 | 73 | 14,11606 | -0,181449 | 1,076421 |
| 1FMT_T2 | 62 | 63,39 | 64 | 33 | 98 | 50 | 75 | 15,63346 | -0,045625 | -0,799962 |
| 1FMT_T/S | 52 | 64,75 | 64 | 40 | 93 | 55 | 73 | 12,92645 | 0,371841 | -0,401093 |
| 2FML_T1 | 81 | 59,11 | 60 | 20 | 90 | 48 | 73 | 17,75528 | -0,089638 | -0,800577 |
| 2FML_T2 | 81 | 62,28 | 63 | 18 | 95 | 55 | 73 | 16,83466 | -0,519016 | 0,084325 |
| 2FML_T/S | 70 | 63,23 | 64 | 40 | 98 | 53 | 73 | 13,28961 | 0,157158 | -0,578393 |
| 2FMT_T1 | 60 | 63,82 | 63 | 33 | 100 | 53 | 75 | 16,19426 | -0,028323 | -0,679554 |
| 2FMT_T2 | 60 | 65,13 | 65 | 15 | 95 | 55 | 75 | 15,27873 | -0,419958 | 0,917165 |
| 2FMT_T/S | 60 | 69,65 | 68 | 38 | 95 | 58 | 83 | 15,37092 | 0,04384 | -1,053228 |

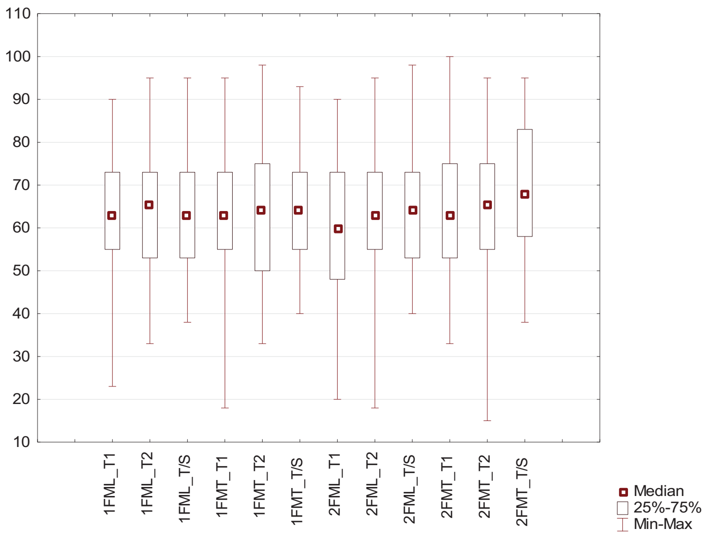


**Figure 1**: Box and Whisker Plot

This Figure (Figure 1) shows that there is no significant difference between test results of the first year students of the Faculty of Military Leadership and Faculty of Military Technologies who started their studies in 2015. More differences are apparent in the test results of students who started their studies in 2014. The first test of the FML (2FML_T1) shows a worse level of English in comparison with the FMT students (2FMT_T1). An interesting fact is that the first test results were worse; however than the test results of the second unsupervised test and the third supervised test do not prove any significant differences. The FMT test results show a growing tendency towards improvement, as the last supervised tests results are the best.

The next step was a test of normality of discussed characteristics which was tested (Johnson, 2006) in all years and tests. The following Figure (Figure 2) is an example of histograms and expected normal distribution for the test results of the FML first year students.

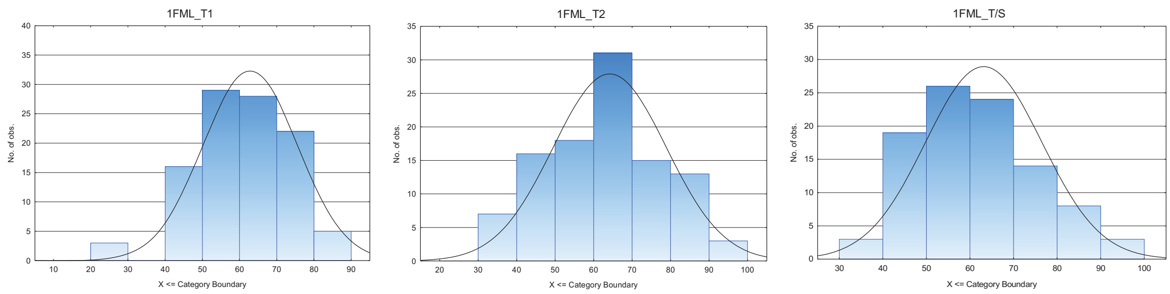


**Figure 2**: Histograms and expected normal distributions for 1FML_T1, 1FML_T2 and 1FML_T/S

Similarly, according to the test results the normality of all described variables is not rejected at a significance level 5%.

## 4.2 Internal analysis of categories

After getting the above mentioned test results, the authors wondered whether the students at the test T2 achieved the same, different, or better results than at the test T1. Similarly, they wanted to find out if students at the test T/S achieved the same, different, or better results than at the test T2. Via a t-test for Dependent Samples (Johnson, 2006), the null hypothesis H: μ_1=μ_2 has been statistically tested against the alternative hypotheses $A: \mu_1 \neq \mu_2$ (or $A: \mu_1 \leq \mu_2$) at the level of significance of 5%. The relations between the tests T/S a T2 have been tested in the same way (Table 2).

**Table 2:** T-test for dependent samples

| year | faculty | T1 and T2 | | | T2 and T/S | | |
|---|---|---|---|---|---|---|---|
| | | *t-test* | *p-value* | *result* | *t-test* | *p-value* | *result* |
| 1 | FML | -1,075 | 0,142 | same | 1,053 | 0,295 | same |
| 1 | FMT | 0,547 | 0,707 | same | 0,633 | 0,530 | same |
| 2 | FML | -2,683 | 0,004 | T2 better | -2,657 | 0,005 | T/S better |
| 2 | FMT | -0,949 | 0,346 | same | -3,166 | 0,001 | T/S better |

According to the test results the null hypothesis $H: \mu_1 = \mu_2$ has been rejected at the significance level of 5% in the case of the first year both the FML and FMT students. The students achieved statistically the same results at tests T1 and T2 and also the same results at test T2 and T/S.

The statistically significant results have been found at the second year students. In the case of the FML students the null hypothesis $H: \mu_1 = \mu_2$ has been rejected at the significance level of 5%. Test T2 results have been better in comparison with the test T1 results. On the other hand, the null hypothesis has been rejected at the significance level of 5% at the second year of the FMT students. Their test T1 and T2 results have not been different.

The null hypotheses that students achieve the same results at the test T/S in comparison with the test T2 have been rejected at the significance level of 5% in the case of second year students, at both FML and FMT. Students of both faculties have achieved significantly better results statistically at the test T/S.

The authors´ further endeavour has been to investigate the relationships, correlations and especially the outliers, which is an observation point that is distant from other observations (Johnson, 2006). An outlier may be due to variability in the measurement or it may indicate experimental error; the latter are sometimes excluded from the data set. Outliers may include the sample maximum or sample minimum, or both, depending on whether they are extremely high or low.

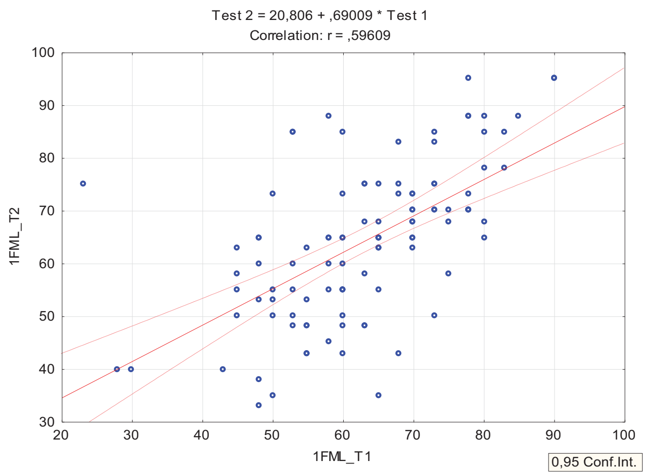


**Figure 3**: Scatterplot for Test 1 vs. Test 2

Linear regression and correlation for variables 1FML_1 and 1FML_2 are shown in Figure 3 and 4. From these Figure it is obvious that some results have been extremely low or high. In the Figure 4 and 8 a blue colour expresses the majority of the test results, and outliers have been shown outside of the blue colour. These Figure (3 and 4) are an example of one variable only. During the analysis the other variables have been tested in the same way.

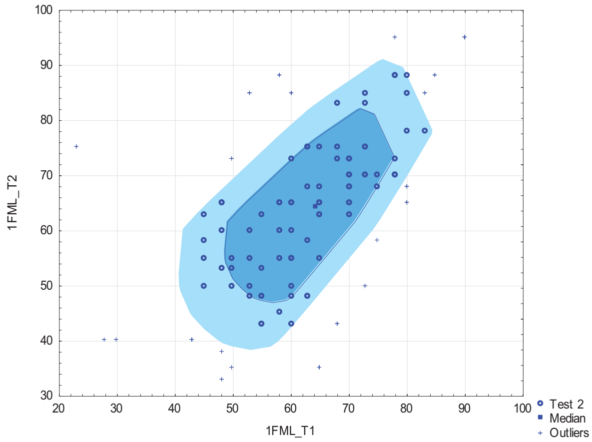


**Figure** 4: Outliers

The next step was to find reasons of extreme outliers via interviews with students. Students admitted that they had cheated in the tests. Some of them wanted to be placed in better study groups in order to have a better chance to achieve better study results and especially to be able to have a better chance to fulfil a fundamental prerequisite for getting a credit in the fifth semester, which is passing NATO STANA 6001 SLP 2222. On the other hand, some students said that a worse group means for them a slower pace of study, revision of grammar, and more concentration on the NATO STANAG 6001 SLP 2222 skills. Both groups of students wanted to achieve their goals by different means. However, after the last testing all students were put in homogenous groups according to their level of knowledge. In homogenous groups the teachers concentrate on students' weaknesses to achieve desired results.

## 4.3 Comparison of results at the Faculty of Military Leadership and the Faculty of Military Technologies

The authors then compared both faculties and their results. In this case they decided on the t-test for Independent Samples (Johnson, 2006) at the significance level of 5%.

**Table 3**: Comparison of FML and FMT results

| year | FML_T1 and FMT_T1 | | | FML_T2 and FMT_T2 | | | FML_T/S and FMT_T/S | | |
|---|---|---|---|---|---|---|---|---|---|
| | *t-test* | *p-value* | *results* | *t-test* | *p-value* | *results* | *t-test* | *p-value* | *result* |
| 1 | -0,612 | 0,542 | same | 0,333 | 0,739 | same | -0,702 | 0,484 | same |
| 2 | -1,615 | 0,109 | same | -1,033 | 0,303 | same | -2,555 | 0,006 | FMT better |

It is possible to confirm that the FML and FMT students achieved statistically identical results for all monitored tests and years. The FMT students have achieved better results than the FML students in the second year of their study only when the T/S tests have been compared at the 5% significance level.

## 5. Conclusion

This article is aimed at measuring the comparability of a pen and paper tests and computer-based tests of two computer tests. Thus far, the authors have found that there is no significant difference between the computer-based tests and the pen-and-paper tests. This indicates that these variables have no effect on the scores of computer-based tests, and consequently there is no impact on the overall validity of the tests. To sum up, there was no significant effect of the testing mode on the overall reliability and validity of the tests.

CALT expands the availability of computer-based testing with all its advantages, and will undoubtedly become a major medium of test delivery in the future. Through all our computer-related language teaching and testing efforts, however, quality and reliability considerations of meeting the standards must be of primary importance. Nonetheless, it is obvious that the computer assisted language testing does not make a good language test without sophisticated expert knowledge of test writing and providing validation.

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# Framework for Students' Online Collaborative Writing

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**Abstract:** The paper focuses on collaborative writing in Google Docs and presents a framework for how students can develop methods for collaborations that include human and non-human actors. The paper is based on the large-scale research and development project *Students' Digital Production and Students as Learning Designers* (2013–2015), funded by the Danish Ministry of Education. The target groups were primary and lower-secondary schools. The project explored teacher-designed frameworks that involved students' agency as digital producers of learning objects aimed at peer students. The project demonstrated that digital production facilitates students' learning processes and qualifies their learning results when executed within a teacher-designed framework that allows for and empowers students' agency. The overall research design was organised as a mixed methods approach. A sub-study within the large project, which is based on an ethnographic approach, shows that the students develop their own strategies for the online collaborative process, through which they organise the work in different ways when interacting with the technological affordances and material performance of the technology. The sub-study also shows that teachers do not introduce or refer the students to online collaborative strategies, roles or communications. The students' online collaborative writing is entirely within the students' domain. On this basis, the paper focuses on how teachers' awareness and articulation of the students' online collaborative writing within a framework can qualify students´ methods to collaborate online with the intention to improve their learning results. In relation to this, the paper explores how digital technologies may act as co-participants in collaboration, production and reflection. Moreover, the framework is designed to help teachers to scaffold students' reflections of their strategies, roles and communications in online collaborative writing processes.

**Keywords:** online collaborative writing, teachers' framework**,** students as learning designers, learning for collaboration, agency

## 1. Project background and introduction

*Students' Digital Production and Students as Learning Designers* was a large-scale research and development project out of five *Demonstration School Projects* that represent the largest single effort initiated by the Danish Ministry of Education. The *Students' Digital Production and Students as Learning Designers*, which ran from 2013 to 2015, involved a consortium of two universities, three university colleges and the LEGO foundation, as well as 13 researchers, 40 teachers and 800 students in total chosen from a pool of candidate schools that applied for participation to meet geographical and socio-economic dispersion. The project built upon our previous research, whose findings challenged the consensus that design for learning belongs to the teachers' domain, as even young students proved capable of dealing with design for learning reflectively and in practise (Sørensen and Levinsen 2014). We also found that staging digital productions as learning objects aimed at peers has a positive impact on students' learning as both a process and a product.

A sub-study within the large project, as based on an ethnographic approach, shows that students develop their own strategies for the online collaborative writing process, through which they organise the work in different ways when interacting with the technology. The sub-study also shows that teachers do not present, introduce or refer to online collaborative strategies, roles in the writing process or ways of communicating and therefore leave the qualifications of the students' strategies, roles and communications entirely within the students' domain. The students' productions are based on their own prior experiences in- and outside of school or on developments in their groups. The involved teachers have not yet discussed how to conduct online collaborative writing in class (Sørensen and Levinsen 2015a).

The study shows that the collaborative processes were peer-to-peer and peer-to-technology processes, in which the students learn to write collaboratively in interactions with the technological actor. The students' own designs for the writing process saw the different groups develop and use several variations between collaborative and cooperative writing strategies in close interactions. The students use different writing strategies, where creating a document in real time, reacting and adjusting to each other's contributions and changes (Lowry, Curtis and Lowry 2004) was an overall and general strategy used during the collaborative writing process. The students' roles in the process were constantly changing. Both students and technologies took on multiple roles and alternated between them. The extent and scope of students' communications depend on their collaborative and cooperative strategies. The students' communicative and reflective competencies are increasingly elaborated on the more often they work collaboratively (Sørensen and Levinsen 2015a).

The students developed their own practices and methods for online collaboration, and the collaborative writing processes were very different. The student groups continued to use their developed collaborative writing practices in Google Docs, regardless of the character of the task. The students' works were only evaluated on the content of the student productions, not on their mode of working (Sørensen and Levinsen 2015a). The study challenges a perspective of learn-to-collaborate, which is in focus in this paper based on the question: *How can teachers support students' online collaboration in writing processes in Google Docs?*

Based on the Design for Learning model below (Figure 1), this paper presents an extended framework that sets the stage for the teacher to be active in relation to students' developments of methods for online collaboration. All the aspects in relation to online collaborative writing mentioned above are taken up and included in the framework.

Figure 1 below illustrates the organisation of the learning design over time, including how the students' full process is embedded into the teacher's *practice-in-class phase*, whereby the teacher acts as facilitator, process manager and project manager in relation to the students. In the *pre phase*, the teacher designs the framework for the students' full process and the expected teacher roles and activities during the *practice-in-class phase*. In the *post phase*, the teacher shares knowledge with colleagues and develops a learning design for future courses. The students in the *pre phase* are introduced to and they co-formulate the learning objectives into evaluation criteria for the *practice/production phase* (Levinsen and Sørensen 2015). During the students' *post phase*, the products and processes are evaluated in various ways based on shared evaluation criteria.


**Figure 1:** Design for learning model**:** The chronological relationship between the teacher and students' work as learning designers

The learning design is dynamic, even though it can be subdivided into phases that are framed by milestones and deadlines. Both the teacher and students have the option of re-designing during a series of iterative activities within their respective *practice phases*, where they exploit new knowledge and qualified feedforward to change and modify approaches and choices in an informed way. In the *practice-in-class phase*, the teacher shifts between two positions. From the participant position, the teacher *reflects in action*, facilitates students and differentiates feedforward in relation to students' abilities and levels. From a withdrawn position, the teacher observes and *reflects on action*, thus producing decision-supporting knowledge regarding whether to proceed or modify the framework. In the *practice/production phase*, the students perform activities similar to those the teacher performs in relation to their production. For example, they use the evaluation criteria to discuss and decide on whether they have performed appropriately and are satisfied with their work.

This model will be taken up in section 5, where the teacher and students' framework for *practice-in-class* is extended, with the goal of developing the students' methods of collaboration in Google Docs. The extended framework will encourage learning-to-collaborate, with the intention that pupils will attain online competencies that will facilitate and support the student when collaborating to learn.

## 2. Related work

Online collaborative writing in schools is a new research field. Some research has been carried out, but mostly in relation to online collaborative writing in workplaces and higher education. Several studies in the field of computer-supported collaborative learning concern the concept of collaboration, among which Dillenbourg (1999) is particularly noteworthy. He distinguishes between collaborative processes and cooperative processes (Dillenbourg 1999). In relation to Dillenbourg's concept of collaboration, Lowry, Curtis and Lowry (2004) provide a taxonomy of collaborative writing. Their article defines collaborative writing terms and builds a taxonomy, including collaborative writing activities, strategies, control modes, work modes and roles. The target group is academia and industry, but parts of the taxonomy are useable in relation to schools.

Zhou et al. (2012) conducted a study on Google Docs through a collaborative writing activity among university students. It showed that Google Docs was considered a useful tool for group work that altered the means of communication. When the students collaborated through Google Docs, students became less dependent on social media, such as Facebook and text messaging (Zhou et al. 2012).

Knain (2009) focused on students' text development processes. He analysed the editing history of co-produced online documents and identified several approaches to text co-production. He found that students to a higher degree add text more often than they revise texts.

Response during the process was studied by Dahl (2006). According to his study, response is a qualifying part of the collaborative writing process, as supported by a recent study by Kraglund et al. (2013), who found that giving and receiving responses is a crucial strategy for improving the quality of online written work.

The advent of several information and communications technology (ICT) applications inspired and initiated studies with a focus on collaborative writing within e.g. wiki-based collaborative writing as an approach to the writing process, which includes collaborative planning, partitioned drafting, peer revising, peer editing and individual publishing (Chao and Lo 2009); blogs for collaborative writing in foreign language learning (Amir, Ismail and Hussin 2011); and the integration of the Internet into English as a second language (Young 2003).

The research on online collaborative writing in school is incomprehensive and, especially, without a focus on the relation between human and non-human actors.

## 3. Research design and methodology

The project is based on a combination of action research and design-based research using quantitative and qualitative approaches. The overall framework for the project includes interventions within different subjects. In accordance with action research, the researchers and teachers collaborate closely when preparing the interventions locally at each school, because the interventions must be integrated into the ordinary planning of the school year. The interventions are in accordance with design-based research, designed with increasing complexity, from simple subject exercises to more complex trans-disciplinary activities that involve advanced technologies, such as social media, robotics or location-based technologies (Sørensen and Levinsen 2014).

The project produces data using two main approaches within an overall mixed-methods framework: 1) baseline measures are conducted as a long-term diachronic quantitative survey combined with qualitative structured observations at the start, middle and end of the project and 2) each of the six interventions are followed through a combined synchronic and diachronic approach, where the researchers follow the interventions to document and identify changes and developments in the performed practice. Qualitative data are collected before, during and after the interventions in the form of individual semi-structured interviews, semi-structured focus groups and informal conversations with teachers and students, as well as videos, photos and artefacts. The aim is to produce a complementary dataset that records and documents the interventions and allows for an analysis of their impact on students' learning and teachers' practices (Levinsen et al. 2014).

## 4. Theoretical frame

The writing strategies can be understood as the procedural processes or the arrangement of the writing processes. Lowry, Curtis and Lowry define writing strategies as, 'A team's overall approach for coordinating the writing of a collaborative document' (2004: 75). The approach of Lowry and colleagues is based on adults in professional work, as they operate with taxonomies of collaborative writing strategies. The taxonomy can also be used to unfold the collaborative processes of the students' work in school. The collaborative writing strategy taxonomy includes single-author writing, in which one person is directed to write for an entire team; sequential single writing, in which one person writes his or her part at a given time and passes the text on to the next person; and parallel writing, in which the team divides the work into units, works in parallel and then gathers the units. Parallel writing can be divided into two main types: horizontal-division writing, in which each person is responsible for a section of the text, which is by the end completed by one person, and stratified-division writing, in which the participants take on different roles, such as author, editor and reviewer. The latter is a strategy of reactive writing, occurring when writers create a document in real time, reacting and adjusting to each other's contributions and changes (Lowry, Curtis and Lowry 2004: 74–79).

When students engage in collaborative writing, their activities and responsibilities change during the process, as do their roles. A writing role in collaborative writing is defined by Lowry, Curtis and Lowry (2004: 75) as the formal or informal responsibility of a participant in a collaborative group, which is known to the group and which lasts for an unknown or set amount of time. They operate with the following collaborative writing roles: writer, consultant, editor, reviewer, team leader and facilitator (Lowry, Curtis and Lowry 2004: 85–87). These roles among the actors, which changed both intentionally and unintentionally during the process, were identified through observations from the four cases.

Communication plays a pivotal part in collaborative processes. It would therefore be appropriate to focus on negotiations and students' types of talk. Negotiation can be understood as an exchange of meaning between students as they try to reach clarification or a mutual agreement during their collaborative writing. Types of talk are important to the quality of the negotiation and the social practice in groups and accordingly to the quality of the collaborative writing work. Littleton et al. (2005) present three types of talk: *disputational talk*, a debating, confrontational, non-constructive conversation with the nature of a controversy that does not lead to collaborative decisions; *cumulative talk,* a conversation in which the participants confirm each other's views and do not discuss or challenge each other, accepting uncritically what has been said and proceeding from there; and *exploratory talk,* a conversation of active joint engagement in which students make assumptions, challenges and discussions, and the progression of the work takes place based on a common acceptance of the proposals. The first two types of talk are not conducive to collaboration.

Online collaborative writing in the school context actualises design for learning. In this respect, McCormick (2004) explores the concept of designing collaboratively, looking at both learning to collaborate and collaborating to learn, two inter-related themes that can be useful for learning designs aimed at collaborative writing. Google docs allow several students to write simultaneously and from several logins. The students' online writing processes are understood, in line with Orlikowski (2009), as a dynamic socio-material configuration in which different human agencies and material performances co-construct different strategies, activities and roles for students and technology. For example, during the writing process, the technological actor performs as an externaliser and mediator of both the students' agency directed towards producing the text and the text as a whole while it emerges. Thus, the technological actor performs in many different ways and with different strategies for various students. We adopt Orlikowski's position that human and non-human actors differ *a priori* with respect to agency and performativity, while the parts they play in the emerging co-construction cannot be determined *a priori* (Orlikowski 2005). Orlikowski (2009) uses the perspective of entanglement in practice, which, in relation to writing processes, includes an understanding of a relational and mutually connected relationship between the student and the technology.

## 5. An extended framework for students' online collaborative writing

Online collaborative writing technologies have entered the educational domain in the Danish school system. Google Docs is one possible online collaborative writing technology that offers both possibilities and challenges. In our earlier research, we found that students develop their own strategies for the online collaborative writing process, through which they organise the work in different ways in interaction with the technological affordances and the material performance of the technology. The teachers did not present, introduce or refer to online collaborative strategies, roles in the writing process or ways of communication, nor did they further introduce the technology and its affordances. The ways of working online were entirely within the students' domain and therefore led to more or less coincidental collaborations, depending on the group dynamic. In light of this, we develop the teacher's framework in the design for learning model (Figure 1) in relation to online collaborative writing in Google Docs.

Figure 2 below can be seen as an extended framework of the teachers' framework in Figure 1, with a focus on online collaborative writing. It amplifies/expands the central box of the figure "Practice in class" and shows how teaching and learning evolve over three layers: the teacher's professional reflections and design for learning at the top (in the framework: Teacher), the interaction between the teacher and the students in the classroom in the middle (in the framework: Teacher and students) and students working together in a group at the bottom (in the framework: Students). When looking at the framework as an elaboration of the middle of the original figure, one must bear in mind the forward-pointing arrow, which proceeds from “pre” to “practice in class” to “post”. This means that even though the framework only represents the center of the figure, it is still a part of the bigger design for learning and part of a continuous learning process. This learning process is to be understood as dynamic, which means that even though it states that the teacher is introducing writing roles, it might not be a fully comprehensive introduction with all of the roles addressed, but an extract relevant to the age of the students and the subject-related content. The next lesson plan and related framework will be influenced by the outcome (“post”) and in this way learn from and build on top of the previous phases.

Teaching deals with two equal foci on learning: the subject-related content and the methods related to collaborative writing. The subject-related content is closely connected to the overall goals for the subject and therefore co-defines the framework. When working with developing the students’ collaborative writing in relation to content, it is relevant to connect to approaches as *creative writing*, *writing in the disciplines* and *writing across the curriculum*, which focuses on the teacher as a supervisor, using dialogue, response (both teacher-to-student and peer-to-peer) and scaffolding as the main guidelines (Fibiger et al. 2009). Meanwhile, even though this approach is represented as the subject-related content in the framework, it is not within the scope of this paper to elaborate further on this. It is foremost included to emphasise the importance of bracketing content and method. In other words, it does not make sense designing a framework for developing online collaborative writing without subject-related content to concretise the teaching through which the collaboration takes place.

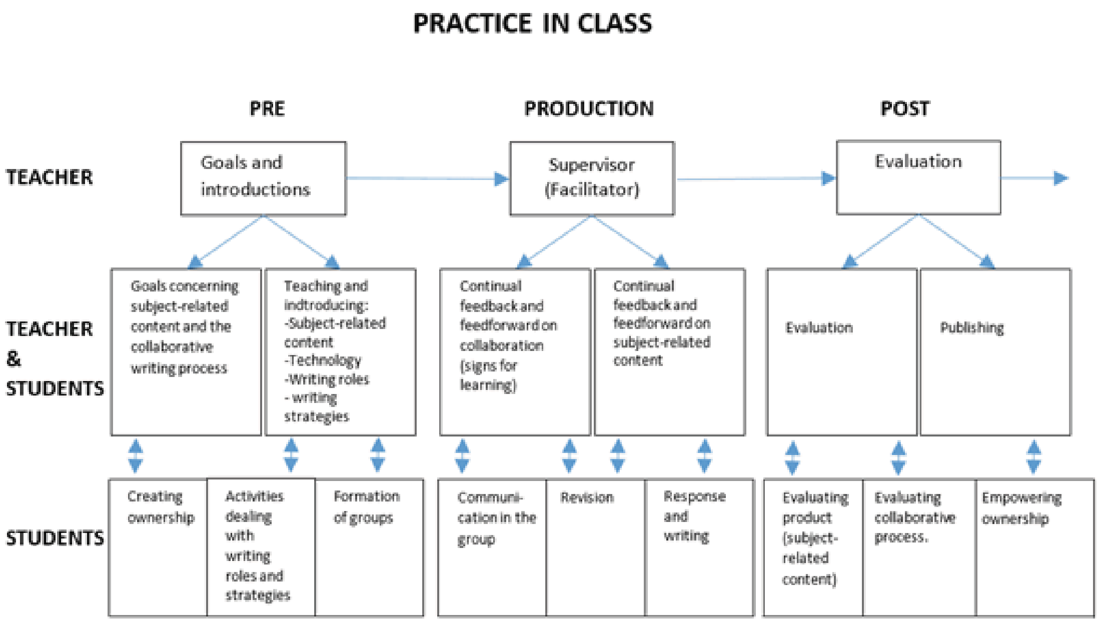


**Figure 2:** An extended framework with a focus on online collaborative writing

The framework divides the teaching into three phases: “pre”, “production” and “post”. During the first phase, the teacher and the students work with goals and with activities introducing both subject-related content and methods related to the collaborative writing process. In that respect, writing roles and writing strategies need to be explicated and taught. The goal is, through the introduction, to provide the students with a range of possible collaboration strategies and to make them experiment with writing roles, that they are not as comfortable with as others are. This can break their customary collaboration patterns and force them to make considered and informed decisions when moving on to the production.

Google Docs is an essential non-human actor in this phase, as well as in the remaining phases, given that the developments of the students’ knowledge of the writing roles depend on the context in which the roles unfold. It is, therefore, insufficient to know the concepts of “editor” or “consultant” when the technological actor, Google Docs, defines and materially performs a digital setting that more or less dictates how the human actors can enact their writing roles. In Google Docs, the collaborative functions, where everyone can write at the same time, make it possible to include, for example, more than one editor, which means that writing roles are not in themselves sufficiently bounded. They must be further defined by the group according to their writing process, which can be a challenge for the students. Google Docs here increases the complexity around the collaborative writing process, which stresses the importance of letting the teacher's framework contain an introduction to the technology in the first phase.

During the production phase, the teacher functions as a supervisor, giving students continual feedback and feedforward. When they concern the students' collaborative process, feedback and feedforward must be of a certain character to facilitate ideal communication within the group. Littleton et al. (2005) state that *exploratory talk* is conducive to collaboration. Examples of observable signs of explorative talk, learning and collaboration are whether the students do/do not "consider alternative opportunities in their work process", "affirm each other just like that" or "build on each other's ideas". When and if the teacher takes these signs into account and involves them in his/her feedback and feedforward, there is a more likely chance that the students' communications will reach *exploratory talk*, because the feedback and feedforward then raise challenges and commitments to the group discussions.

The arrows connecting level two and three are pointing in both directions to indicate that when the teacher has initiated a feedback and feedforward situation, the students will not only revise their work, but also be inspired to give a peer-to-peer response (Sørensen and Levinsen 2015b). Their peer-to-peer response will influence the classroom and from there lead to new teacher feedback/feedforward and then again, new revisions will be made. Consequently, levels two and three in the framework influence each other continually.

Furthermore, Google Docs' material performance makes it possible for the teacher and for the students to add a digital dimension to the enactment of their feedback and feedforward. The technology allows the participants in the document to review and comment via specific editing functions. These make it possible to give feedback and feedforward across time and the physical boundaries constituting the classroom, which can enhance the face-to-face supervision of the teacher over the students. The material performance of the editing functions in Google Docs also makes it possible for the students to better enact some of the emerging writing roles. For example, the consultant and the reviewer will stand out more clearly due to the technology.

During the third and last phase, "post", the teacher initiates an evaluation of both the product and the collaborative process. The evaluation, in line with the rest of the framework, focuses on dialogue and not merely between teacher and student, but also among the students themselves to ensure the empowerment of ownership over the writing product and their individual and collective learning results concerning collaborative writing skills.

## 6. Conclusion and perspective

Earlier research has shown that teachers have not presented or introduced the students to online collaborative writing, nor have they discussed it in class. The students' productions are based on prior experiences or developments of different writing strategies and different choice of roles in their groups. The students' online collaborative writing is entirely within the students' domain. On this basis, the paper has developed an extended model in relation to the teachers' framework in Figure 1, with the intention of improving the students' collaborative methods and subsequently the quality of their learning.

The extended framework model is one teachers can use to plan their teaching and students' learning processes, with the intention of supporting students' online collaborative writing. The model provides suggestions on how teachers in different phases of students' processes can introduce, support and facilitate students' online collaborative writing so that the students can better reflect and selectively decide which type of writing strategies are relevant to qualify their academic learning and which roles will be effective to use in different writing processes. Furthermore, it gives suggestions for how students can develop appropriate ways of communicating that promote both their learning and their collaborative processes. Finally, the student–technology interaction is also a parameter in the model. Students are introduced to reflect on and experiment with the affordances and the material performance of the non-human technological actor. The model is developed in relation to online collaborative writing in Google Docs, but the model can also be used with small modifications in relation to the co-construction performance of other technologies, through which students collaborate online, e.g. multimodal production programmes.

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# Comparing Student Activity and Performance in the Classroom and a Virtual Learning Environment

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**Abstract:** In recent years, we have witnessed an increasing use of e-learning in higher education, triggered by both new educational technologies and new pedagogical approaches. This development raises questions about how students learn in virtual learning environments (VLEs) compared to traditional classroom environments. While several case studies have examined this question, they are often based on single course iterations and there is a lack of longitudinal and quasi-experimental comparative studies. In this paper, we examine how student activity and performance are related in a graduate course in applied physics that was reformed by replacing the traditional classroom environment with a VLE. We use longitudinal data from six iterations of the course, of which half were campus based and half were conducted online. We analyse quantitative data based on home assignments, the students' participation in course activities as well as the quantity and quality of questions that students posed during the course. The results show that there is no statistically significant difference in the students' average performance across the two formats. However, for the VLE there is a substantially greater variation in individual performance. Moreover, the participation in synchronous activities in the VLE, such as online wrap-up sessions and tutorials, is strongly correlated with improved student performance. Further, students that asked content-related questions are more likely to achieve better outcomes. We conclude that despite the reported benefits of video lectures, even when augmented with built-in quizzes, these are not sufficient for encouraging a deep approach to learning. Our results provide further evidence that video lectures need to be accompanied by other learning activities that require students to engage in higher-order thinking skills. We discuss our results in the light of related empirical and theoretical work, and highlight implications for teaching in blended and virtual learning environments.

**Keywords:** virtual learning environments, learning analytics, student performance, student activity, higher education

## 1. Introduction

The rapid development and availability of information technology and the internet has triggered technology driven change in higher education. Universities as traditional institutions of higher education are increasingly enhancing traditional classroom experiences with open, web-based and blended forms of teaching and learning by, for example, incorporating Learning Management Systems and Virtual Learning Environments (VLEs; e.g. Britain and Liber, 2004) in campus education or by engaging with Massive Open Online Courses (MOOCs; e.g. Daniel, 2012). Some teachers attempt to combine the benefits of web-based learning and in-class meetings in more blended forms, for example by applying a flipped classroom model (Bishop and Verleger, 2013).

For more than two decades, scholars have tried to examine how effective web-based courses are compared to traditional classroom education in higher education. Research on technology enhanced learning in the early and late 90s mainly focused on video and audio technology. This strand of research has not found a significant difference in student performance in traditional face-to-face instruction versus technology-supported environments (see Russell, 1999 for a large review). Thus, one can argue that it is not the technology itself, but the instructional model that determines learning outcomes (Piccoli et al, 2001).

In contrast to early uses of technology in education, modern technologies - particular web based technologies provided by VLEs - have the potential to significantly alter the educational environment. VLEs provide a number of advantages in terms of increased convenience and flexibility. One of the key arguments for using VLEs is the increased amount of learner control – the students need to make their own decisions about pace, flow or order of instruction (Williams, 1996). Laurillard (2002) has classified different media forms of learning technologies that VLEs can support:

- Narrative media for attending and apprehending (e.g. texts, videos, audio, images)
- Interactive media for investigating and exploring (e.g. libraries, search engines, web links)
- Communicative media for discussing and debating (e.g. discussion forum, chats, email)
- Adaptive media for experimenting and practicing (e.g. online simulation, virtual labs, online quizzes)

- Productive media for expressing and presenting (e.g. blogs, wikis, word processor, spreadsheet)

Most VLEs, however, appear to primarily focus on the first and second (narrative and interactive) media (Lameras et al, 2012). Research on web-based training and VLEs became more apparent around 15 years ago. In one of the first studies, Piccoli et al (2001) did not find any significant difference in student performance between VLEs and traditional teaching. They did, however, report an increased self-efficiency but lower levels of student satisfaction in VLEs. Similarly, de Jong et al (2013) and Li et al (2014) also reported an indistinguishable performance between classroom-based teaching and online teaching. Li et al. (2014), however, pointed out that e-learning enhanced higher-level learning. On the other hand, Chou and Liu (2005), for example, found that students in VLEs show better performance, higher levels of self-efficacy, satisfaction and learning. Al-Qahtani and Higgins (2013), comparing classroom teaching, online learning and blended learning in an experimental design, concluded that the latter outperformed the two others in terms of student performance, but observed no difference between the pure classroom and online format. In a recent review of research on the flipped classroom model, O'Flaherty and Phillips (2015) indicated that there is a lot of indirect evidence of improved student performance and satisfaction for this blended learning model. Thus, blended forms of learning appear to be preferred over either one of the pure online or classroom teaching environments, a result that also is confirmed by Tayebinik and Puteh (2013). Nevertheless, O'Flaherty and Phillips (2015) also stressed that there is a lack of conclusive evidence that blended learning contributes to building lifelong learning and other 21st century skills. Finally, McCutcheon et al (2015) pointed at the wide variation in the type of online and blended learning approaches. They nevertheless concluded that online learning is as effective as traditional teaching and were not able to provide any clear conclusions for blended learning approaches.

In sum, while there are no definite findings on whether or not traditional teaching outperforms online learning or vice versa, there are indications that approaches that are sensitive to the particularities of both the campus and online learning environments result in better student performance. Thus, the rapid technological development needs to be accompanied by pedagogical approaches that fit technology-based learning environments and further research is needed to explore conditions that optimize student learning in VLEs.

In this article, we contribute to this discussion by examining how the teaching environment, student activity and student performance are related in a graduate course in applied physics. The course (taught by the second author) was first delivered in a traditional classroom environment, but was later revised and delivered in a VLE. Thus, we have longitudinal data over six course iterations. The use of educational technology also made it possible to collect new kinds of evaluation data, enabling us not only to analyse student performance in tests but also to examine their activity for different, ungraded elements of the course. More specifically, two research questions are addressed in this article:

- How does the reform from a traditional classroom environment to a VLE affect student performance?
- How does student activity and feedback impact student performance in the VLE?

## 2. Methods

In this study, we examine the relation between learning environment, student activity and performance using quantitative data based on home assignments, the students' participation in course activities as well as the quantity and quality of questions that the students posed during the course. In this section, we describe the pedagogical approach and set-up of the course during the different iterations. We start with a description of the course, followed by information about the data collection and analysis process.

### 2.1 The course

Our analysis is based on the course *Modelling of Nuclear Reactors*, offered to master and PhD students at Chalmers University of Technology. The aims of the course are for the students to be able to comprehend and apply the solution methodology of the computer codes used by the nuclear community for simulating the behaviour of nuclear reactors. The main emphasis of the modelling course is to derive the typical algorithms, approximations, and the corresponding limitations, so that the students can apply the codes with confidence in situations that fall within the validity of the algorithms. The curriculum for the course is organized in four chapters. For each chapter, students need to submit a home assignment, where they apply some of the algorithms presented in the course to solve practical problems. Thereby, they have to develop their own codes and write reports accordingly. In addition, the students write short summaries after each chapter that are peer reviewed. That creates an opportunity for students to reflect on their peers' contributions, and indirectly on their own. In order to pass the course, students need to attend at least 75% of the web-casts, complete all summaries (that are nevertheless ungraded) and the home assignments.

We use longitudinal data from yearly iterations of the course over six years, starting in 2009, and during which the course was reformed from a campus-based format to a pure web format. During the first two years, the course was delivered in a traditional campus-based format. In the third year, the course was also offered in a campus-based format, but the in-class sessions were recorded and made available to the students after class. For the three following consecutive years, the course was entirely delivered in a VLE. In year four, the course was offered in a web-based format with asynchronous parts (webcasts) and synchronous parts (tutorials). During the last two years, the web-based format was enhanced by including online quizzes and synchronous wrap-up sessions, and the final version of the course consisted of the following elements:

- Pre-recorded lectures (webcasts) that were available to students for on-demand viewing;
- Tutorials that were live-broadcasted with synchronous interactions between the students and the teachers;
- Online quizzes embedded in the webcasts and that focused on conceptual understanding;
- Regular synchronous wrap-up sessions designed to address the students' needs and based on the input from the students; and
- A discussion forum.

The wrap-up sessions were part of a Just-in-Time Teaching approach (JiTT; Watkins and Mazur, 2010) and designed to address the students' needs and based on the input from the students. In addition, students were provided with feedback prompts to pose questions to the teachers while watching the lectures. They also had the opportunity to rate the lectures and provide more specific feedback on the lectures. The discussion fora were created to enable students to interact with each other, and provided valuable information for formative feedback and necessary interventions. Nevertheless, the discussion fora were exclusively used for the home assignments.

The course is hosted on a VLE (or learning management platform) called Ping Pong, developed by Ping Pong AB, Sweden. This VLE is used as an entry portal to all electronic resources in the course. In addition, Ping Pong is utilized for managing the online quizzes, the rating of the webcasts, the feedback on the webcasts, and the discussion fora. The webcasts are recorded and broadcasted (for on-demand viewing exclusively) using Mediasite, developed by Sonic Foundry Inc., USA. Finally, the wrap-up and tutorials are live-streamed, as well as recorded for later on-demand viewing, using Adobe Connect, developed by Adobe Systems Inc., USA.

## 2.2 Data collection

Ping Pong, Mediasite, and Adobe Connect all offer the possibility to monitor students' activity and performance, even if the level of detail of the available data significantly differs between the three platforms. As all three platforms collect their data separately, we could not connect the data on an individual student level. Instead, comparisons between the different factors were made on aggregate level between the different course iterations. This reduces the interpretability of the analysis somewhat, but still offers relevant results. In the following we briefly present the different factors we measured and how we operationalized them.

### *2.2.1 Student performance*

To measure performance, we include the students' results on the home assignments that are available for all six years. During the first four years, three home assignments were offered. A fourth home assignment was added thereafter. The addition of a fourth assignment was decided after analysing the results of the final course evaluations, in which students expressed a wish to have an additional home assignment on the last chapter of the course. The same assignments were kept during the six iterations of the course, with the fourth assignment being added from the fifth course iteration. The students' performance on such assignments can thus reliably be compared from year to year. The number of students enrolled in the different course iterations was similar but limited (see Table 1). However, the teacher considered the level of the students at the start of the course as very similar each year. As a result, inter-comparison of the students' performance from year to year is possible. Differences in students' performance can thus be attributed to the modifications brought to the pedagogical approach followed during the successive course iterations. We report on average performance as well as standard deviations for all six course iterations hereafter.

**Table 1:** Number of students completing the first home assignment

| Year | Number of students |
|---|---|
| 2009/2010 | 14 |
| 2010/2011 | 7 |
| 2011/2012 | 10 |
| 2012/2013 | 10 |
| 2013/2014 | 8 |
| 2014/2015 | 11 |

### *2.2.2 Student activity*

Student activity relates to the level that students participate in the different course activities. Our data is limited to the last three years, when the course was delivered in a VLE. We focus on the students' participation in synchronous course activities, i.e. the tutorials for the three last course iterations and the wrap up sessions for the last two iterations, as no comparable wrap-up session was offered during 2012/2013. The monitoring of the synchronous sessions was performed using the data available from Adobe Connect for all students that also submitted the home assignments (see Table 1).

### *2.2.3 Student feedback*

The last indicator measures the amount and kind of feedback students give on the course content. That can be done by monitoring the questions sent to the teachers while the students attend the different webcasts. The questions were then manually extracted and ordered by topic. After the initial set-up resulted in assignment-related questions only, the objective of the second course reform in 2013 was to encourage students to pose and discuss questions that relate not only to the home assignments but also to the contents presented during the webcasts. Those questions that were not dealing with the home assignment were also extracted and categorized based on whether they relate to the content or administrative aspects. Finally, those questions that were content-related were categorized by one of the co-authors according to their cognitive level in Bloom's taxonomy (e.g. Krathwohl, 2002).

## 3. Results

### 3.1 Analysis of student performance on home assignments

The average student scores for the four home assignments over six course iterations are illustrated in Figure 1. For home assignment #1-#3, the average performance tends to be better during earlier iterations of the course, delivered in a traditional classroom format. In particular, for the last course iteration, the performance dropped significantly for assignments #2 and #3. Similarly, we see a significant drop for assignment #4. Thus, student performance did not improve by delivering the course in a VLE.

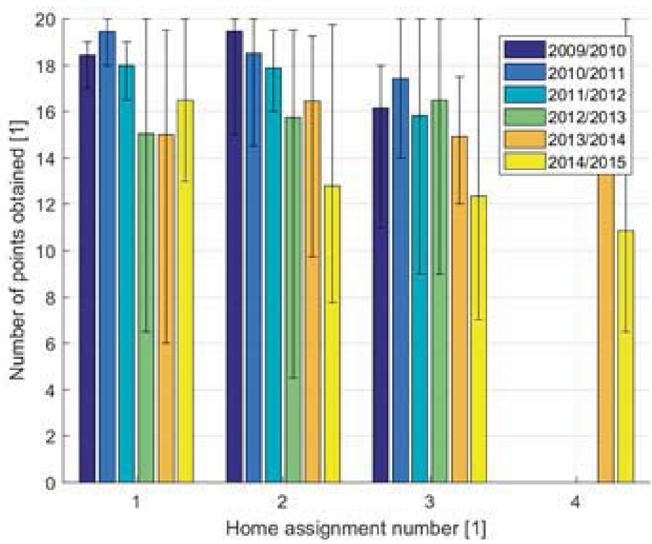


**Figure 1:** Average student scores for the four home assignments over six course iterations

The analysis of student performance can be enhanced by not only looking at the average scores on the home assignments, but also at the variation between students. The standard deviation for the four assignments is presented in Figure 2. For the traditional format, the standard deviation is generally significantly lower than for the VLE. So while in the traditional format the results of the home assignments were fairly homogeneous among the students, we see a much larger variation in student performance for the online format. For the course iterations 2012/13 as well as 2014/2015 the standard deviation was comparatively high for all three respective four assignments. The year 2013/14 appears somewhat exceptional with high variation in home assignments #1 and #2 but a comparatively low standard deviation for assignments #3 and #4.

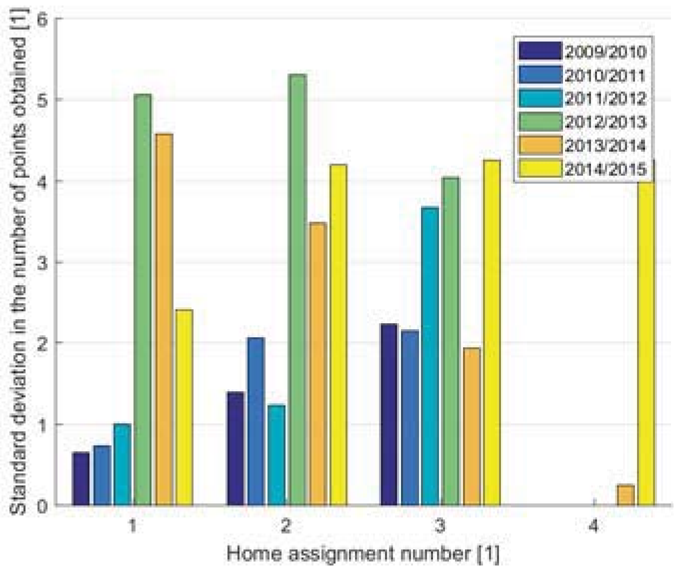


**Figure 2:** Standard deviations for the four home assignments over six course iterations

### 3.2 Analysis of student attendance in synchronous sessions

Figures 3 and 4 show student attendance in the live-broadcasted sessions, i.e. the four tutorials and the four wrap-up sessions. While the available data are limited, Figure 3 shows that student attendance in the tutorials was at similar levels for the first and second tutorial, but was significantly lower in the last iteration of the course for the third and fourth tutorial. With respect to attendance in the wrap-up sessions, a great difference between the two course iterations was observed (Figure 4). While over two thirds of the students participated in all the wrap-up sessions during 2013/2014, only about one third of the students did so in the following year.

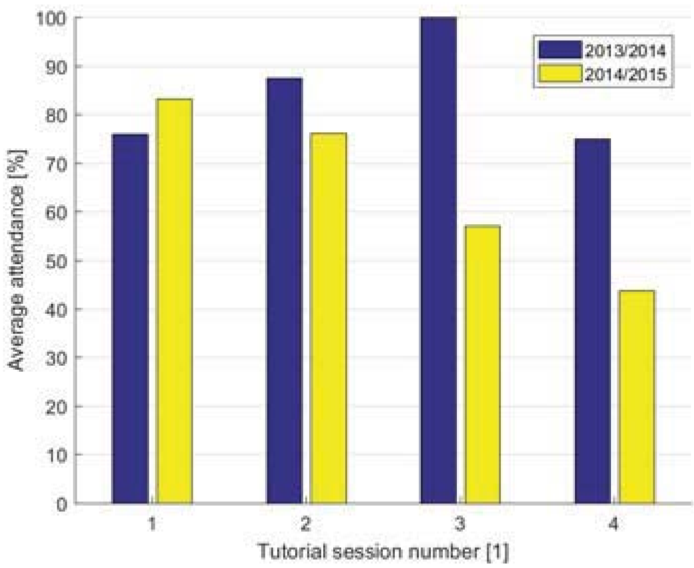


**Figure 3:** Student attendance in the tutorial sessions

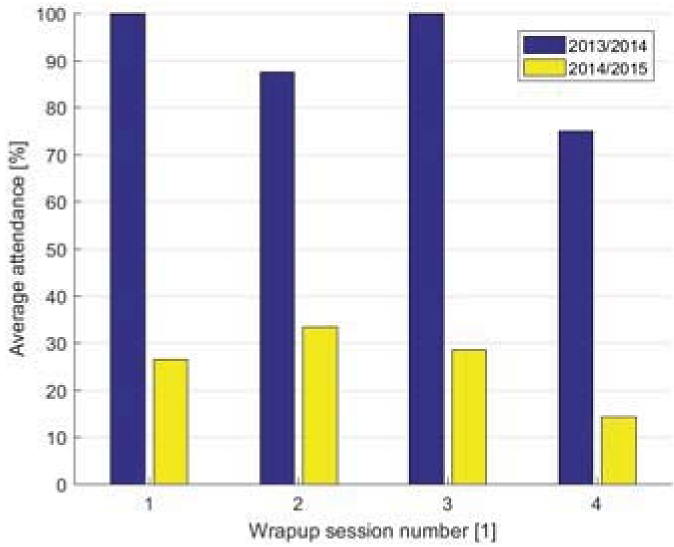


**Figure 4:** Student attendance in the wrap-up sessions

### 3.3 Analysis of student questions sent to the teacher

We also analyzed the questions posed to the teachers by looking at the the amount and quality of course content-related questions posted (Table 2). Although a forum was available in the course since 2012/2013, the forum was exclusively used for questions related to the home assignments. After the course reform, the teachers also received questions on the home assignments. Home assignment-related questions (either sent to the teachers or collected via the forum) are not considered in the analysis reported hereafter.

**Table 2:** Questions sent to the teachers (excluding questions related to home assignments)

| Academic year | Total number of questions | Number of content-related questions | Number of administrative questions |
|---|---|---|---|
| 2012/2013 | 0 | 0 | 0 |
| 2013/2014 | 39 | 16 (42%) | 23 (58%) |
| 2014/2015 | 57 | 2 (4%) | 55 (96%) |

In the course iteration 2013/2014 the students posted 39 questions on aspects of the course that are not related to the home assignments, of which a bit more than half (58%) was of administrative nature and the rest were content-related. In the academic year 2014/2015 even more questions (57) were received. However, 96% of those were of administrative nature, only 2 of the questions addressed content aspects of the course.

Finally, we categorized the content-related questions according to their cognitive level using the revised version of Bloom’s taxonomy (Krathwohl, 2002). Due to the limited number of questions, this analysis could only be meaningfully done for 2013/2014. From Figure 5, it can be seen that with the exception of “creating”, the students posed question covering all cognitive levels of the taxonomy. Most of the questions posed by the students belong to the “understanding” level, followed by the “analyzing” level and the “evaluating” level. However, it is worth noting that more than half of the questions were at a higher level of understanding (above “remembering” and “evaluating”). The two content-related questions in the last course iterations were categorized in the categories “evaluating” and “creating”.

## 4. Discussion and conclusions

In this article, we have examined student performance in an applied physics course that was reformed by replacing the traditional classroom environment with a VLE. The results show that there is no statistically significant difference in the students’ average performance across the two formats. Thus, the use of a VLE did not improve student performance. If anything, and against our expectations, performance even got somewhat worse. This is consistent with most of the results from previous research presented in the introduction. However, from the analysis of standard deviations, we conclude that there are significant differences between the two formats. For the VLE, there is a substantially greater variation in the individual student performances. It seems that for VLEs, stronger students become even stronger, while struggling students perform even worse. This could be explained by the fact that an online course, with its increased flexibility, requires a higher degree of self-regulation. In other words, VLEs place higher demands on students for taking responsibility and control over their learning. It is therefore important to consider how to provide struggling students with the necessary support and scaffolding in online and blended learning environments, such as the increasingly popular flipped classroom model.

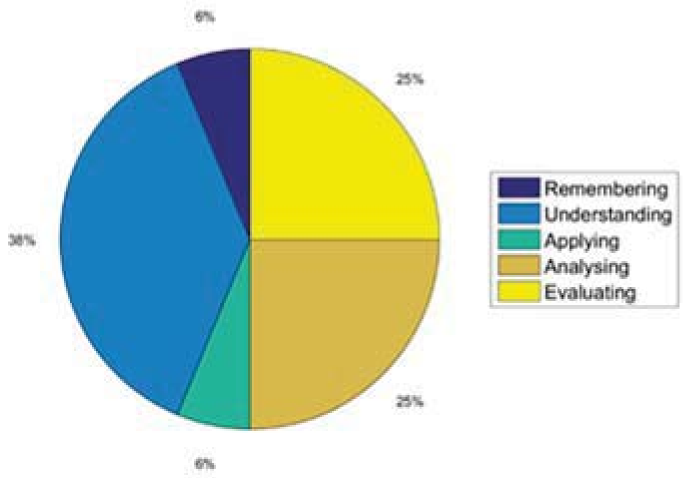


**Figure 5:** Classification of student questions according to their cognitive level in Bloom's taxonomy

Comparing student performance and participation in the online wrap-up sessions and tutorials in the VLE, we see that activity and performance was high in 2013/2014 but both were low in the following year. This is an indicator confirming that the students' participation in synchronous sessions and performance are correlated. Thus, synchronous parts in a course (online or in class) appear to be of central importance for student learning and asynchronous video lectures alone are not sufficient to create deep learning, even when augmented with built-in quizzes.

Similarly, we observed that high content-related activity in the form of questions sent to the teachers and subsequent interactions was accompanied by better student performance. Note that it was not the number of questions itself that made the difference, but whether or not questions at a higher level of understanding were posted. Questions of administrative nature did not contribute to learning. However, while both activity and formulation of questions appear highly correlated with performance, and a causal relationship might appear intuitively correct and consistent with the predictions of modern learning theories, our analysis is limited by the use of different data sources on aggregate level. We cannot exclude the possibility that those results are due to common co-variates. For example, more motivated students might also be more likely to pose questions and also perform better.

In sum, we conclude that the use of a VLE is not better or worse than traditional teaching, but teachers need to consider and help their students to adapt to the specific benefits and challenges of VLEs. Video lectures alone are not sufficient for encouraging a deep approach to learning, but need to be accompanied by other learning activities that require students to engage in higher-order thinking skills. However, as reported recently in a review by Maarop and Embi (2016), instructors engaging in online and blended learning often struggle to develop such a well-crafted design, and need support in terms of time, pedagogical and technical skills and finding the right balance between classroom, online and blended teaching. Thus, making the most of online and blended teaching is not only a challenge for teachers but also institutional actors in higher education.

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# The Role of Text Messaging in Team Collaborative Learning

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**Abstract:** Teamwork is essential to the successful completion of group tasks, and is therefore usually highlighted by universities as a desirable graduate attribute. To encourage the development of good teamwork skills among students, many university courses incorporate team assignments. In a conventional learning environment, students meet face-to-face in the classroom or somewhere on campus to complete their team assignments. However, it is interesting to note that today's students prefer instead to have discussions or to collaborate using digital media. Today's students use such digital communication media as email, text messaging, video chat, etc. to collaborate with team members in the process of completing their team assignments. As the students are familiar with and use some of these digital communication media in their everyday activities, it is quite possible that they also find them convenient and easy to use for academic work purposes. According to Nowak, Watt, and Walther's (2005, 2009) efficiency framework, people tend to select communication media that they consider more effective in achieving certain objectives and those that require less cognitive and behavioural effort, and less time. However, is it true that digital communication media indeed help users to achieve greater team effectiveness, or is it just a perception myth? This study attempted to examine, when university students used text messaging for team collaboration purposes, if text messaging affected their copresence (modelled as a second-order formative construct which consists of two subconstructs: self copresence and partner copresence), media satisfaction, and perceived team effectiveness. This study conducted a questionnaire survey to collect responses from students who had been involved in team projects, and performed a partial least squares analysis of the responses. The findings show that copresence had a significant relationship with media satisfaction; media satisfaction had a significant relationship with perceived team effectiveness; and media satisfaction had a partial mediating effect between copresence and team effectiveness. This study could help explain why students may choose text messaging to facilitate team collaborative learning.

**Keywords:** collaborative learning, copresence, digital communication media, efficiency framework, media satisfaction, team effectiveness

## 1. Introduction

Technology, especially mobile devices such as smart phones and tablets, have impacted many aspects of our lives, particularly in the areas of communication and collaboration. Modern digital communication media allow us to be connected anywhere and anytime. According to Statistica.com (2016), in the month of April 2016, there were 1,000 million active users of WhatsApp, 900 million active users of Facebook Messenger, and 853 million active users of QQ Mobile.

Given the popularity of digital communication media (e.g. WhatsApp, Facebook Messenger and QQ Mobile), it is possible that students may find them convenient, and thus use them in teamwork and collaboration for completing assignments. In light of this, this study investigates why students may choose text messaging to facilitate team collaborative learning.

## 2. Research background

### 2.1 Communication media

Communication is vital to team collaboration; in order for teams to work effectively, there must be clear communication among team members. The study of communication has long championed the idea that the best communication occurs over channels that are rich, like face-to-face communication (Behring and Xu, 2014; Okdie et al., 2011). However, with the prevalence of digital communication media, there are now more ways to communicate and facilitate team collaboration. Apart from direct face-to-face communication, video chat and text messaging also provide alternative ways to collaborate.

Nowak, Watt, and Walther (2009) point out that communication media are different in terms of features and characteristics. These different features and characteristics affect the communication medium's efficiency, how users interact in a communication situation, as well as users' satisfaction with the medium. High-cue communication media are generally considered to require less communicative effort, and thus are more efficient in facilitating communication as compared to low-cue communication media. Low-cue communication media not only require more communicative effort from the users to process information, users also need to learn to adapt their communication behaviours to these media accordingly. On the one hand, the extra effort may result in less satisfaction with low-cue communication media. On the other hand, the extra effort may help enhance the levels of copresence (i.e. the users perceive that they and their partners have all contributed meaningfully to the group) and group effectiveness; and if the users work together toward some common interaction goals, they can achieve successful interaction outcomes. It is interesting to note that despite the users being satisfied with their preference for a particular communication medium, it does not necessarily result in a successful interaction outcome (Walther, 2011).

### 2.2 Nowak, Watt, and Walther's efficiency framework

Nowak, Watt, and Walther (2009) proposed the efficiency framework to depict the relationships among the constructs copresence (consisting of self copresence and partner copresence), perceived group effectiveness, media satisfaction, and outcome success. To test their hypotheses, they conducted a study in which university students used face-to-face communication or one of the four computer-mediated communication media (i.e. synchronous high-cue, synchronous low-cue, asynchronous low-cue, and asynchronous high-cue) when working in groups. Their findings showed that communication media that were synchronous or had fewer cues contributed to higher levels of copresence (but they did not find the same support for greater group effectiveness). Face-to-face communication as well as communication media that were synchronous or had more cues resulted in higher levels of media satisfaction.

### 2.3 Research model

With reference to Nowak, Watt, and Walther's (2009) efficiency framework, this study proposed a research model (Figure 1) to examine the effect of copresence on media satisfaction and perceived team effectiveness in a situation where university students used text messaging as their primary medium of communication for team collaboration purposes. In this study, copresence was conceptualised as a second-order formative construct (consisting of two first-order reflective constructs: self copresence and partner copresence) (MacKenzie, Podsakoff and Jarvis, 2005). Supposing that students who were satisfied with their use of text messaging would perceive team effectiveness to be better, it was hypothesised that a higher level of copresence would contribute to a higher level of media satisfaction (H1), which would eventually result in a higher perceived level of team effectiveness (H2).

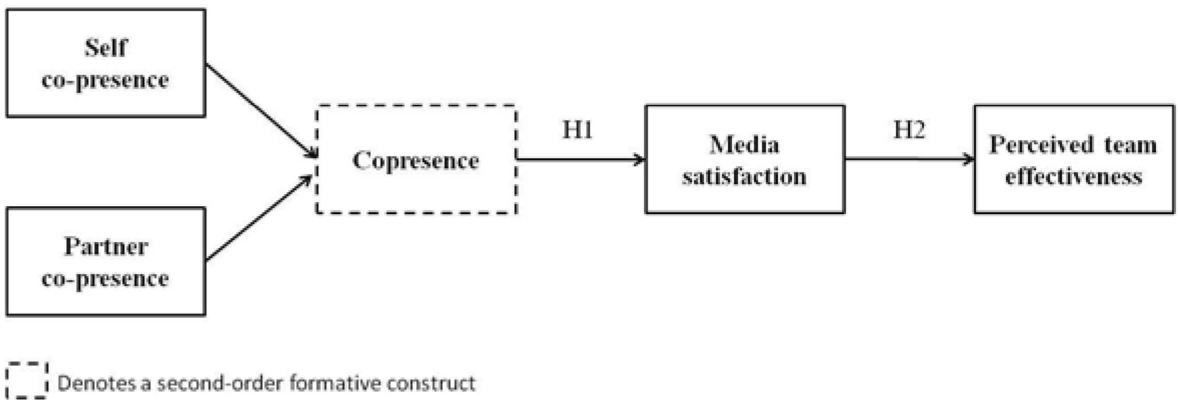


**Figure 1:** Research model

## 3. Research method

### 3.1 Construct operationalisation

To operationalise the constructs, some scale items were adapted from Nowak, Watt, and Walther (2009) and some new ones were developed. Table 1 presents a summary of the operationalisation of the constructs.

**Table 1:** Operationalisation of the constructs

| Construct | Level | Type | 1st order sub-construct | Type | Number of items |
|---|---|---|---|---|---|
| Copresence | 2nd order | Formative | Self copresence | Reflective | 6 |

| Construct | Level | Type | 1st order sub-construct | Type | Number of items |
|---|---|---|---|---|---|
| | | | Partner copresence | Reflective | 6 |
| Media satisfaction | 1st order | Reflective | -- | -- | 6 |
| Perceived team effectiveness | 1st order | Reflective | -- | -- | 6 |

### 3.2 Data collection

An online questionnaire was used to collect responses from the students who had been involved in team projects at a local university. Section A asked three questions about their digital media usage. Section B asked four questions in relation to the constructs. All items were measured using a 5-point Likert-type scale, 5 being "strongly agree" and 1 being "strongly disagree." Section C asked one demographic question. As the focus of this study was on the use of text messaging for team collaboration purposes, only the students who used text messaging (e.g. WhatsApp, LINE, WeChat, etc.) as their primary medium of communication when working in teams on a class project were included in the data analysis. A total of 51 respondents provided the responses. One response was removed as an outlier for not meeting the Mahalanobis distance criterion (Tabachnick and Fidell, 2007). As a result, only 50 responses were included for subsequent analyses.

## 4. Data analysis and results

### 4.1 Text messaging usage

Table 2 presents the frequency of the teams using text messaging as a primary medium of communication for team collaboration purposes. 11 respondents reported a frequency of 1 to 2 times in a week (22%); 16 respondents 3 to 4 times (32%); ten respondents 5 to 6 times (20%); one respondent 7 to 8 times (2%); one respondent 9 to 10 times (2%); and 11 respondents more than 10 times (22%).

**Table 2:** Usage of text messaging for team collaboration purposes

| | | N | % |
|---|---|---|---|
| Frequency of the teams using text messaging for team collaboration purposes in a week | 1 to 2 times | 11 | 22.0 |
| | 3 to 4 times | 16 | 32.0 |
| | 5 to 6 times | 10 | 20.0 |
| | 7 to 8 times | 1 | 2.0 |
| | 9 to10 times | 1 | 2.0 |
| | More than 10 times | 11 | 22.0 |

Table 3 presents a summary of the reasons the teams chose to use text messaging for team collaboration purposes. In terms of percentage, the top three reasons were: "it made communication easy" (64%); "it made communication convenient" (60%); and "it made communication quick" (56%).

**Table 3**: Reasons to use text messaging for team collaboration purposes

| | | N | % |
|---|---|---|---|
| Reasons to use text messaging for team collaboration purposes | It made communication easy. | 32 | 64.0 |
| | It made communication convenient. | 30 | 60.0 |
| | It made communication quick | 28 | 56.0 |
| | It allowed talking to many people at the same time. | 26 | 52.0 |
| | It allowed communication at any location. | 25 | 50.0 |
| | It made communication effective. | 16 | 32.0 |
| | It made communication real time. | 10 | 20.0 |
| | It costed minimal to communicate. | 9 | 18.0 |

Table 4 presents a summary of the challenges the teams faced when using text messaging for team collaboration purposes. In terms of percentage, the top three challenges were: "responses were not immediate" (52%); "there was less face-to-face interaction" (50%); and "there was a lack of non-verbal communication" (20%).

**Table 4:** Challenges in using text messaging for team collaboration purposes

| | | N | % |
|---|---|---|---|
| Challenges in using text messaging for team collaboration purposes | Responses were not immediate. | 26 | 52.0 |
| | There was less face-to-face interaction. | 25 | 50.0 |
| | There was a lack of non-verbal communication. | 10 | 20.0 |
| | There was too little communication. | 9 | 18.0 |
| | There were miscommunications. | 8 | 16.0 |
| | It was difficult to understand what was communicated. | 7 | 14.0 |
| | There were psychical meeting constraints. | 6 | 12.0 |
| | There was too much communication. | 4 | 8.0 |

## 4.2 Confirmatory factor analysis

This study used the SmartPLS software to perform a confirmatory factor analysis (CFA). Following the two-step approach as recommended by Gerbing and Anderson (1988), the measurement model was first assessed, followed by the structural model. The measurement model was assessed for internal consistency reliability, convergent validity, and discriminant validity. The structural model was assessed for significance of path coefficients and $R^2$ (Hair et al., 2014).

To assess the higher-order reflective-formative model (i.e. the two first-order reflective constructs form the second-order formative construct), this study followed the suggestion by Hair et al. (2014). First, latent variable scores of the two first-order reflective constructs were obtained using the repeated indicator approach. Then, the latent variable scores were used as the indicators of the second-order formative construct.

### *4.2.1 Measurement model*

*Internal consistency reliability* - For satisfactory internal consistency reliability, composite reliability of individual reflective constructs should be above 0.7 (Fornell and Larcker, 1981; Gefen and Straub, 2005). Table 5 presents a summary of CRs, AVEs, and correlations of the first-order reflective constructs. It was evident that these constructs showed good internal consistency reliability (CR>0.7).

**Table 5:** CRs, AVEs, and correlations of first-order reflective constructs

| Constructs | CR | AVE | Media satisfaction | Partner copresence | Perceived team effectiveness | Self copresence |
|---|---|---|---|---|---|---|
| Media satisfaction | 0.931 | 0.694 | 0.833 | | | |
| Partner copresence | 0.965 | 0.821 | 0.852 | 0.906 | | |
| Perceived team effectiveness | 0.970 | 0.845 | 0.904 | 0.858 | 0.919 | |
| Self copresence | 0.953 | 0.771 | 0.811 | 0.866 | 0.852 | 0.878 |

Note: CR: composite reliability; AVE: average variance extracted; square roots of average variances extracted (AVE) are shown on diagonal; correlations between constructs are shown on off-diagonal.

*Convergent validity* - For satisfactory convergent validity, loading of individual indicators should be above 0.7 to be statistically significant and the average variance extracted (AVE) of individual constructs should be above 0.5 (Fornell and Larcker, 1981; Gefen and Straub, 2005). Table 5 shows that the AVEs of the constructs were above 0.5. Table 6 provides evidence of high indicator reliability, as the loadings of individual constructs were above 0.7 (and were statistically significant at 0.000).

*Discriminant Validity* - For satisfactory discriminant validity, indicators should load above 0.7 on their intended construct and meet the Fornell-Larcker criterion (i.e. square root of the AVE of each construct should be larger than its correlations with any other construct) (Fornell and Larcker, 1981; Gefen and Straub, 2005). Table 6 shows the cross loadings of the indicators across the constructs and it is evident that the indicators loaded above

0.7 on their intended constructs. Table 5 shows that all the constructs except media satisfaction met the Fornell-Larcker criterion.

**Table 6:** Factor loadings and cross loadings of first-order reflective constructs

| Constructs/loadings | Self copresence | Partner copresence | Media satisfaction | Perceived team effectiveness | p-value |
|---|---|---|---|---|---|
| I participated during our team interactions. | 0.911 | 0.752 | 0.707 | 0.778 | 0.000 |
| I found our team interaction engaging. | 0.822 | 0.761 | 0.711 | 0.686 | 0.000 |
| I was intensely involved in our team interactions. | 0.909 | 0.789 | 0.675 | 0.722 | 0.000 |
| I was interested in our team interactions. | 0.869 | 0.736 | 0.742 | 0.797 | 0.000 |
| I did not feel bored during our team interactions. | 0.864 | 0.771 | 0.752 | 0.770 | 0.000 |
| I was willing to listen to my team members during our team interactions. | 0.889 | 0.752 | 0.687 | 0.737 | 0.000 |
| Team members were willing to listen to me during our team interactions. | 0.820 | 0.846 | 0.666 | 0.761 | 0.000 |
| Team members were intensely involved in our team interactions. | 0.793 | 0.937 | 0.800 | 0.771 | 0.000 |
| Team members seemed to find our team interactions engaging. | 0.804 | 0.909 | 0.837 | 0.802 | 0.000 |
| There was a sense of closeness among the team members during our team interactions. | 0.775 | 0.898 | 0.759 | 0.758 | 0.000 |
| Team members were interested in our team interactions. | 0.769 | 0.908 | 0.805 | 0.786 | 0.000 |
| Team members showed enthusiasm for our team interactions. | 0.745 | 0.937 | 0.758 | 0.786 | 0.000 |
| I got a good enough idea of how my team members' at the other end were reacting during our team interactions. | 0.814 | 0.767 | 0.847 | 0.816 | 0.000 |
| I was able to assess my team members' reactions to what I said during our team interactions. | 0.763 | 0.653 | 0.834 | 0.739 | 0.000 |
| Our team interactions were like I was in the same room with my team members. | 0.560 | 0.658 | 0.786 | 0.616 | 0.000 |
| This medium of communication facilitated my group's ability to complete the project. | 0.722 | 0.805 | 0.833 | 0.855 | 0.000 |
| I would choose to use this medium of communication if I wanted to persuade others of something. | 0.625 | 0.651 | 0.882 | 0.751 | 0.000 |
| I could get to know my team members well through this medium of communication. | 0.517 | 0.698 | 0.811 | 0.702 | 0.000 |
| Our team interactions were very beneficial. | 0.732 | 0.755 | 0.850 | 0.901 | 0.000 |
| I got what I wanted out of our team interactions. | 0.738 | 0.783 | 0.819 | 0.900 | 0.000 |
| I found our team interactions useful and helpful. | 0.800 | 0.801 | 0.828 | 0.954 | 0.000 |
| My team did a good job on the team project given our constraints. | 0.821 | 0.843 | 0.870 | 0.941 | 0.000 |
| I achieved everything I hoped in our team project. | 0.759 | 0.789 | 0.840 | 0.911 | 0.000 |
| My contribution to the team was effective. | 0.854 | 0.757 | 0.773 | 0.906 | 0.000 |

*Second-order Formative Construct* - Using the latent variable scores of the two first-order reflective constructs (self copresence and partner copresence) as the indicators of the second-order formative construct (copresence), the outer weights of the indicators were assessed. The weight of the indicators indicated their relative contribution to the formative construct. The weight of partner copresence was 0.696 (p=0.001) and that of self copresence was 0.335 (p=0.083). Although the weight of self copresence was not statistically significant at 0.05 level (it was at 0.1 level though), its loading was above 0.5 (p=0.000). As suggested by Hair et al. (2014), if the outer weight of an indicator is not significant, its outer loading should then be assessed. If the outer loading is above 0.5 and statistically significant, the indicator can be retained for its absolute importance. To assess if there were collinearity issues, the variance inflation factor (VIF) and tolerance level of each indicator were calculated. The VIF of both indicators were below 5.0 (3.996 for both) and the tolerance level was above 0.2 (0.25 for both). Thus, collinearity problems did not exist.

*4.2.2 Structural model*

The structural model was examined next. A bootstrapping procedure of 1,000 sub-samples was used to calculate t-statistics of the path coefficients between the constructs (Gefen, Straub and Boudreau, 2000). Figure 2 shows that the copresence construct had a significant relationship with the media satisfaction construct and explained about 74.7% of its variance ($R^2$=0.747). Media satisfaction had a significant relationship with perceived team effectiveness and explained about 81.7% of its variance ($R^2$=0.817).

To assess if media satisfaction had a mediating effect between copresence and team effectiveness, the direct effect and indirect effect (both were statistically significant) were first calculated. The variance accounted for (VAF) was then calculated to determine the size of the indirect effect in relation to the total effect. If VAF is below 0.2, there is no mediation; between 0.2 and 0.8, partial mediation; and above 0.8, full mediation (Hair et al., 2014). Results showed that media satisfaction had a partial mediating effect (VAF=0.469), i.e. about 46.9% of copresence's effect on team satisfaction was explained by media satisfaction.

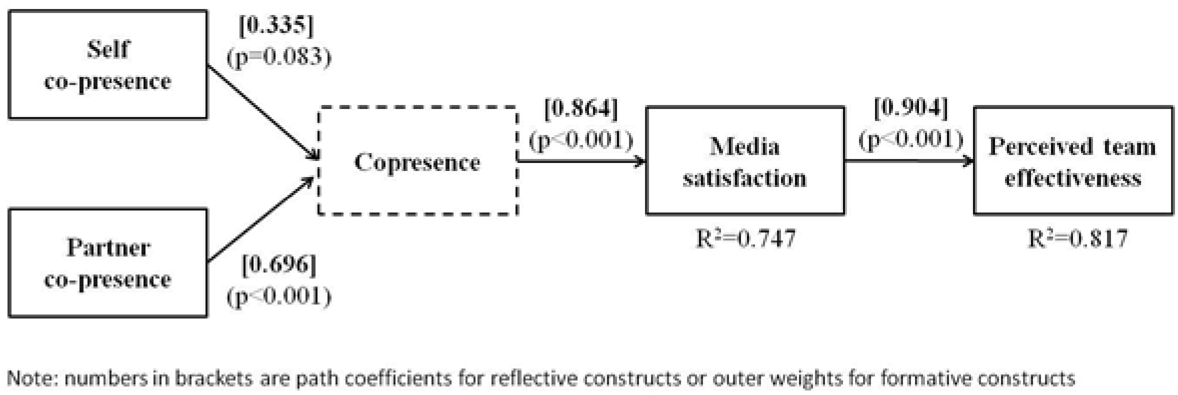


**Figure 2:** Structural model

## 5. Discussion and conclusions

The findings of this study show that copresence had a positive significant relationship with media satisfaction. This supports the hypothesis (H1) that copresence would contribute positively to media satisfaction. In real terms this relationship indicates that when team members have high copresence, they tend to be satisfied with their choice of digital communication medium. Given that the choice of digital communication medium in this study was text messaging, the findings show that the students may believe that text messaging allows them to contribute meaningfully to the team and therefore they perceive the team to be effective.

The findings of the study also show that media satisfaction had a positive significant relationship with perceived team effectiveness. This supports the hypothesis (H2) that media satisfaction would result in a perception of team effectiveness. The relationship between media satisfaction and the perception of team effectiveness indicates that once the team is satisfied with the choice of digital communication medium, they will believe that the team operated effectively.

The direct effect between copresence and perceived team effectiveness was statistically significant. This may be an intuitive result in that when team members feel that they have all contributed meaningfully to the team effort, they will perceive that the team as a whole was effective. However, what is worth noting is that media satisfaction had a partial mediating effect between copresence and team effectiveness. This implies that satisfaction with the communication medium helps explain the perception that the team is effective.

Overall, the result of this study highlights that the choice of digital communication medium is an important consideration for students working in teams. High copresence of team members can contribute to students' satisfaction with the digital communication medium. However, it is worth pointing out, as Nowak, Watt, and Walther (2009) noted, that despite the students being satisfied with their preference for a particular communication medium, it does not necessarily result in a successful outcome.

Whilst the outcome of the team assignment was not captured in this study, it is reasonable to assume that text messaging could have severe limitations as a communication medium for team assignments. One obvious limitation is the restricted amount of information that can be communicated at a time as well as the propensity for miscommunication. Thus, when working in teams on projects, teams should note such limitation when relying primarily on the use of text messaging for team collaboration purposes. Despite these obvious limitations, the teams in the study were quite satisfied with the use of text messaging and perceived that the teams were effective

### 5.1 Research limitations

Three research limitations should be highlighted. First, this study did not assess the relationship between perceived team effectiveness and project outcome, e.g. grades. Second, this study only focused on text messaging and did not include other digital communication media for comparison. Third, this study could not isolate the effect of text messaging when other digital communication media were also used by the same team to supplement team collaboration.

### 5.2 Future research directions

To further our understanding in the use of digital communication media for team collaboration purposes, four future research directions can be considered: (1) To examine and compare groups of synchronous, asynchronous, low-cue, and high cue digital communication media, e.g. Facebook, video chat, voice call, etc.; (2) To examine the use of digital communication media in business for team collaboration purposes, e.g. project management; (3) To expand the research model to include a construct to measure project outcome, e.g. grade obtained for a team project, team performance on meeting different project criteria, etc.; and (4) To examine and compare the use of face-to-face communication and other digital communication media in different countries or cultural settings.

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# Using an Electronic Portfolio to Support the Learning Process of Lower-Secondary School Pupils When Choosing a Career

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**Abstract:** The paper reports on the concept, implementation and findings of qualitative research focused on an electronic portfolio (e-portfolio). The research aimed to explore the use of an e-portfolio in the learning process of lower-secondary school pupils (ISCED 2) in the Czech Republic concerning their career choice. The primary research question was defined as whether we can consider an e-portfolio as an appropriate learning tool to support pupils' preparation for their career choice. The research sought to a) analyse the current process of pupils' preparation for their career choice, b) evaluate the appropriateness of an e-portfolio as a supportive learning tool for career choice based on the experience from last years, c) evaluate the appropriateness of an e-portfolio for the pupils' self-reflection and self-evaluation development, d) suggest optimum learning scenarios, which could be implemented into learning through educational activities. In the first stage of the action research, the pupils described their preferred occupation and specified formal and informal job requirements using cloud technologies. In the second stage, a teacher assessed pupils' work with the assistance of an external interviewer. In the third stage, pupils prepared a CV and cover letter for an imaginary employer using a professional portfolio. An imaginary recruitment process followed. It was organised by an external interviewer using pupils' job applications.

**Keywords:** e-portfolio, cloud, lower-secondary school, career choice, evaluation, self-reflection

## 1. Introduction

A pupil portfolio can be generally defined as a collection of outcomes or artefacts *„documenting and archiving information about a pupil's work. It is an organized collection of a pupil's work collected within a certain period of time providing various information about his or her experience and accomplishments"* (Šteflová, 2006). In addition to traditional assessment methods, such as marking or oral assessment, pupil portfolios offer another way of school assessment. Portfolios are also used for evaluation in lifelong education (JISC, 2008) and in addition to a pupil portfolio; we can also work with a teaching portfolio or institutional portfolio (Cambell, 2011). In terms of a form, we can consider a pupil portfolio comprising written, drawn, printed, in other words generally materialized outcomes (a print-based portfolio) and a portfolio containing electronic data, in other words documents (an electronic portfolio).

Based on the previously carried out research, there has been seen an upward trend in the use of electronic pupil portfolios in schools and out-of-school activities (Becta, 2009; Fuglík, 2012). This trend may be attributed to a wider use of the electronic form of the portfolio supported by the increasing availability of information and communication technologies (ICT), a broadband Internet access and improving level of users' information literacy (Lorenzo, Ittelson, 2005).

One of the existing forms of portfolio within professional education or generally in terms of education is called professional portfolio. Its use is apparent in a wide range of occupations including teachers (a teaching portfolio), for whom lifelong learning is essential (Campbell et al., 2011). In this connection, we talk about a working and presentation form of a portfolio. A working form is usually built by pupils themselves and it usually covers a certain period of time. A presentation form is the aggregation of the pupil's best works, with the choice of which a teacher or external authoritative figure may help (Baumgartner, 2009).

## 2. Research design

The research aimed to explore the use of an e-portfolio in the learning process of lower-secondary school pupils (ISCED 2) in the Czech Republic concerning their career choice. The research was conducted as action research lasting three months taking place in two 8th grades involving 46 pupils and a school year before there was a pre-research lasting the same amount of time involving 41 pupils. The primary research question was defined as whether we can consider an e-portfolio as an appropriate learning tool to support pupils' preparation for their career choice.

The research sought to a) analyse the current process of pupils' preparation for their career choice, b) evaluate the appropriateness of an e-portfolio as a supportive learning tool for career choice based on the experience from last years, c) evaluate the appropriateness of an e-portfolio for the pupils' self-reflection and self-evaluation development, d) suggest optimum learning scenarios, which could be implemented into learning through educational activities.

The following subsidiary research methods were used: a content analysis method used to collect documents and data, a method of participant unstructured observation realised by the teacher and a structured interview method with open questions held by a teacher along with an external authoritative figure (Hendl, 2008).

## 3. Research field

The research was carried out in the school, the catchment area of which is a standard residential district of the capital city. This school comprises both a primary and lower-secondary school involving 1st – 9th grade (1st – 5th grade ISCED 1 and 6th – 9th grade ISCED 2). This school year, 565 pupils attend the school in 25 classes taught by 43 teachers and four teaching assistants. 8th grades participated in the project. They are part of the lower-secondary school consisting of two classes in each year having 20-26 pupils in one class. The lower-secondary school pupils usually achieve better results in comparative tests carried out during a school year than it is the average in whole Prague and the Czech Republic. Generally we may conclude that the test results and pupils' achievements participating in the research correspond to pupils' relatively high motivation for learning reflecting their personal inclinations and stimulating school environment, as well as family background. At the same time, pupils with special learning needs and specific learning disabilities are part of both classes. Their presence in the class requires the adjustment of learning goals, content and methods.

The mentioned research was conducted within a learning project in Technology lessons, in which the issue of career choice is taught in the fourth quarter in 8th grade according to School Education Programme. A Technology teacher and a researcher took part in the pilot study of the research. The following year, a Technology teacher, who carried out most of the activities with their pupils and was a researcher at the same time, participated in the research. Further on, there were two more teachers from the school cooperating within interdisciplinary links in Civic Education and Financial Literacy; and there was also an external authoritative figure participating in conducting interviews with pupils and evaluating the learning project in its final stages. The role of an external authoritative figure was given to the second researcher. Both researchers then worked on designing the concept of a learning project, on its implementation including data collection and their evaluation.

We chose Mahara (www.mahara.org) tool for the e-portfolio administration. It is a native web application for building and administration of electronic portfolios enabling to record the process of pupils' learning having features of a social network providing room for their mutual communication. Creating and implementing this application into school practice was part of one of the pillars of the current New Zealand curriculum in the field of evaluation and self-evaluation. Mahara is open source software with open source code under the GNU General Public License 3.

For research purposes, we used UMIM.TO (umim.to) web portal run by Charles University in Prague, Faculty of Education. It is based on Mahara version 15.10 application released in October 2015. The application is complemented by a Czech localization (gitlab.com/umim-to/mahara-cs-test/tree/15.10_STABLE) prepared within Department of Information Technology (it.pedf.cuni.cz). The portal aims to offer schools a space for creation, administration and sharing of electronic portfolios and enable to work with them to enhance pupil's development, self-evaluation and self-reflection, to improve the use of portfolios for individual work and group projects and to facilitate mutual communication between pupils, teachers, parents and communication among themselves and schools as well (Fuglík, 2011).

Since the school year 2009/2010, the school, in which the action research was conducted, has been using services available within an educational set of the Google Apps for Education (www.google.com/edu/) cloud package. It is a localized file of solutions enabling communication and data sharing within a specific community clearly defined by users consisting of teachers and lower-secondary school pupils. During the learning process, as well as during other educational activities, both teachers and pupils use cloud tools primarily to create, share, publish and showcase the outcomes of activities. During the learning project realized within the research, Google Drive tool proved especially useful, within which pupils used most the following applications: Documents, Sheets, Slides and Drawings to create date files containing outcomes of pupils' work. Google Drive, or some of the web publishing tools, eg. Google Sites, Hangouts, etc., proved to be the most useful for the purposes of sharing and publishing segments of work. The advantage of Disk Google is that it enables to use its shared content in the environment of Mahara application, or UMIM.TO portal.

During the research, pupils prepared their imaginary professional portfolio showcasing their results and other related contents using the above mentioned tools, which they afterwards transformed into a presentation portfolio, with which they would apply for a job at the end of the learning process. In terms of classification of their activities, it was actually a professional portfolio with elements of a presentation portfolio.

## 4. Research course

### 4.1 Pilot study

In the school year 2014/2015, the organisation scheme of the research was based on the pilot study conducted with a similar research sample comprising 41 pupils in two classes with the same education programme in 8th grade in lower-secondary school. These pupils were preparing for a career choice in accordance with the content of curricular documents in Technology lesson. The basic concept of activities and the time allocated for pilot research were the same as in the subsequent research project. The topics and learning objectives were identical as well. However, pupils used different tools for work. The main difference between the pilot research and the one conducted a year later lay in the fact that during the pilot research pupils created their portfolios using no specific tool for their administration. They collected results in various ways. The outcome of the activities realized within the pilot research was a comprehensive file of materials, but in very different formats and on different storages, or on data drives (e.g. cloud environment Google Drive, One Drive, Drop Box or network computer drive, USB flash drive, etc.). Inconsistent forms of pupils' outcomes significantly influenced the quality of pupils' work, both from pupils' and teachers' side and an external authoritative figure participating in the educational activities, or evaluation of the results of joint work.

As stated above, the concept of the pilot research corresponded to the existing research. Hence research stages, individual sub-tasks, as well as the primary task were identical for both surveys. The researchers intended to carry out both surveys (the pilot and existing) in the way that they would match as much as possible in the content, time schedule and their findings would be comparable to the greatest possible extent. For this purpose, identical research methods were employed in both surveys, i.e. content analysis of the outcome documents and data, unstructured participant observation and structured interview with open questions. The most significant difference between both surveys was the targeted implementation of Mahara, a tool for the administration of electronic portfolios, through UMIM.TO, a specialized installation environment.

### 4.2 Learning project

The concept of the whole learning project contained four interlinked stages based on the pupils' activities. In the first research stage, pupils prepared the characteristics of their preferred occupation and a specification of formal and informal job requirements under the teacher's supervision within unstructured participant observation. In the second stage, a teacher with the assistance of the external authoritative figure carried out the evaluation of the pupils' documents using content analysis. In the third stage, pupils prepared their CV and a letter of motivation for an imaginary employer in the form of a professional portfolio working in e-portfolio environment. An imaginary recruitment process followed. It was organised by an external interviewer using pupils' job applications in the form of a structured interview with open questions. Based on the results of the recruitment process, the pupils carried out a self-reflection of their submitted work considering selected occupations and outcomes from the imaginary employer using an e-portfolio.

Other activities connected to manuals for various environments (Google Drive and Mahara, or UMIM.TO portal), or transmitting theoretical knowledge from thematic fields of career choice and career preparation complemented the project stages. These supplementary activities played also an important role in the learning project as using an electronic environment is based on having the know-how. Sufficient theoretical background allowed for necessary orientation in the issue and successful task completion. The theoretical part of the learning project interlinked in many points with the content of pupils' practical tasks so that the tasks helped pupils to understand the issue better and to gain necessary knowledge. In order to transmit the theoretical content, various forms and procedures were used whereas the methods of frontal teaching, group and collaborative learning and theoretical elements of constructivist approach proved most useful.

Universally transferable digital learning objects were used to a great extent in this part of the learning project. They were specifically designed for these purposes and they comply with the principles and requirements provided for their identification. We assumed that digital learning objects meeting the criteria can be repeatedly used with the same effect on ICT means of various types and characteristics (Tocháček, 2015).

46 pupils from two classes took part in the existing learning project in the school year 2015/2016 and one teacher, who participated in all its stages. In the stages focused on the evaluation of pupils' outcomes within the learning activities, another researcher joined the research in the role of an external interviewer as an imaginary recruitment specialist. Two more teachers from the school participated indirectly in the project by realizing learning activities in other subjects within the targeted interdisciplinary cooperation and cross-cutting topics sharing. These teachers were teachers of Financial Literacy and Civic Science. In their lessons within the interdisciplinary links, they talked about pupils' career choice and pupils prepared their outcomes.

Pre-conceptual activities thematically focused on career choice and career preparation were the first stage of the action research in the form of a learning project. Pupils got familiar with basic terms from the field, but they did not get any further information on the topic. The reason for this was to ensure to the greatest possible extent a full unlimited development of pupils' ideas about the topic and simultaneously to set up conditions stimulating pupils need to search for the necessary information in external resources and this information process. The creation of a comprehensive electronic outcome in any format (a document, presentation, broadsheet, collage, multimedia object) of an appropriate extent was central to pupils' practical activities, by means of which pupils collected and expressed their ideas about their future career. After completion, this material was shared by a teacher through Google Drive and at the same time pupils could keep it in this environment for a further use and future export to UMIM.TO portal. The material involved a content analysis carried out by researchers with the following items:

- Expected area of interest of occupational orientation, or a particular occupation (when indecisive more areas or occupations). Basic characteristics (properties, specification) of the occupation;
- reasons for the choice of the career or areas of occupational orientation;
- expected demands on the training for the profession and gaining the employment in the field or area of occupational orientation;
- assumed formal qualifications (e.g. study programme, certificates, practice, etc.) and informal (e.g. communication skills, personal characteristics, etc.);
- potential further vocational guidance, professional development;
- assumed advantages and disadvantages of the occupation or occupational orientation;
- possibilities for re-training from the occupation or occupational orientation taking advantage of the previous training and practice.

A follow-up activity realized in the first stage of the learning project constituted active individual pupils' work on creating clear characteristics of the national educational system and labour market taking account of their preferred occupation or area of occupational orientation with teacher's participant observation using a precisely defined observation scheme. A brief indication of the possibilities for use of educational institutions abroad with regard to permeability of the system, transfer mechanisms and recognition of qualifications within open international labour markets was part of the pupils' work.

During this individual activity, pupils again generated electronic outcomes having no specific assignment for the form. Teacher's conditions for the acceptance of the results were the following: pupils had to meet the criteria defined for the content quality and in terms of the form they had to make the outcome available within the shared environment. In order to achieve the goal defined for this part of the project, pupils were to create outcomes so that it was obvious they were able to identify individual parts of the system and they understood the relations between them.

The second activity stage of the learning project consisted of pupils' writing CVs, letters of motivation and creating electronic portfolios. Pupils equipped with sufficient amount of theoretical knowledge and information coming from the introductory activity stage, during which they articulated their ideas of their future occupation and occupational orientation, created their own CVs, letters of motivation and in the teacher's presence they created comprehensive portfolios. During this stage of the learning project, new electronic outcomes were developed in the form of CVs and letters of motivation; comprehensive files of materials were created when CVs, letters of motivation, earlier created pre-conceptual materials, materials summarising information on educational systems, but completely new materials as well, such as certificates and outcomes from various previous and existing activities in other subjects and out-of-school activities were combined into one file – an e-portfolio. Pupils' work on electronic portfolios was closely monitored by researches in accordance with prepared observation scheme and outcomes from this stage were subject to an in-depth analysis.

The third activity stage of the learning project concerned an imaginary selection procedure at the prospective employer, or in the HR company, as a structured interview. At this stage, an external interviewer joined the project, a co-author of the research in the role of a human resources specialist, who the pupils had not met so far and who went through and evaluated pupils' materials stored in the electronic environment and simultaneously in teacher's presence he or she conducted the imaginary selection interviews with pupils in the form of a structured interview. The assessment of all parts of the professional portfolios and analysis of the imaginary interview were part of the interview.

During the final stage of the learning project, which followed up immediately after the third stage, all the participants of the learning project shared and discussed knowledge and experience gained from all the stages of the learning project and they co-participated in the evaluation of the individual phases, including generating general outcomes and recommendations for optimising procedures for planning a personal study and professional development and career choice. Within the UMIM.TO portal, a group was set up for this purpose. In this group, pupils can share their outcomes and provide feedback to each other.

## 5. Results

The research in the form of action research took place within a learning project in primary and lower-secondary school with the use of a content analysis of the school works, participant unstructured observation in class and structured interviews with pupils. After the achievement of the objectives, an analysis of the current pupils' preparation for their career choice was conducted. The evaluation of an e-portfolio as an appropriate tool to advance learning focused on career choice was conducted based on the past experience, namely the pilot research project. It was also assessed whether an e-portfolio is a powerful tool that develops pupils' self-reflection and self-evaluation. Finally, learning scenarios used in the educational activities were suggested and verified in their practical implementation.

During the assessment of the results, pupils' outcomes produced during the stages of the learning project were thoroughly analysed. In the first place, these were the electronic outcomes summarising pupils' ideas about their further study, career preparation and career choice. Secondly, these were materials focused on the description of the educational system taking into account pupil's preferred study pathway and occupational orientation. The content of the background materials included in pupils' electronic portfolios was thoroughly compared with the content of other outcomes included in the complex of an e-portfolio, primarily with a CV and a letter of motivation. As a basis for an overall evaluation of the study, we carried out observations of pupils' solving strategies for the assigned tasks and used data recorded by researchers during the interviews with pupils. Simultaneously, we assessed relevant outcomes, as well as pupils' e-portfolios with the statements made by the pupils during the imaginary selection procedures with an external interviewer.

When observing the results obtained in the previously conducted pilot study, it seems that the comprehensiveness of the pupils' outcome has a positive influence on meeting the learning objectives. Completing the tasks and preparing materials led to insufficient mastering of the issue in the pilot study. Pupils gained some knowledge and skills in the field, but the level of their knowledge and skills was not sufficient after the learning had been completed. This statement can be supported by particular pupils' outcomes, which show significant incoherence and content inconsistency, even though this requirement was clearly stated in the instructions and thus expected by the researchers. On the contrary, after the realization of the existing learning project, the analysis of the available materials shows that the outcomes from the pupils' work from the stages of the learning project are mostly closely interwoven (both content and form). Most pupils managed to create from sub-materials a comprehensive complex of values in the form of a professional portfolio illustrating their ideas about follow-up study, career preparation and career choice. Pupils acquired necessary skills related to the development of an occupation-oriented presentation portfolio as well.

The assessment of the pupils' activities in the final stage of the learning project provided researchers with valuable information enabling them to assess the significance of an e-portfolio as a self-evaluation and self-reflection tool for pupils. The discussion conducted in both classes and follow-up individual interviews showed that a comprehensive file of materials, i.e. an e-portfolio, is perceived as a valuable material, which can be used for the given purposes. Planned activities leading to the preparation of a professional, or presentation portfolio were evaluated positively by the pupils and almost in all cases the learning objective and overall objective of the learning project were well understood. When comparing the results of the learning project and the pilot study, in which pupils often did not meet the defined learning objectives and the feedback showed they did not understand the purpose of particular steps, we may draw positive conclusions in favour of the future use of electronic portfolios when developing pupils' career preparation.

During the research and within the individual objectives, researchers concluded that an e-portfolio can be considered a useful tool to advance learning. The answer to the primary research question can be moreover supported by the fact that an e-portfolio is an effective tool, which, when used for 8th graders' career preparation, enables a more effective and better achievement of the learning objectives than when the traditional tools are used. The opinion is based on the findings of the research, primarily the comparison of the results of the pilot study and the current learning project.

## 6. Discussion

The biggest limits of the research for the researchers were a short period of time of the research determined by the maximum possible length reserved for the topic in Technology lessons, or Civic Science and Financial Literacy, and the length of lessons for pupils' practical work. It is also necessary to take into account 8th graders' abilities and skills in the field of information technologies and the level of their acquisition in primary and lower-secondary school.

We should bear in mind that one of the researchers works also as a teacher in the school, where the research took place. Knowing the environment and pupils' possibilities for learning or an opportunity to monitor the whole research work could be an advantage. The disadvantages could be an excessive level of personal involvement, mainly in the parts concerning evaluation. To keep a sufficient distance, the teacher-researcher cooperated in such moments with other two colleagues and another researcher in the role of an external authoritative figure, who had no previous links to the school nor pupils and he could thus assess their work, implementation of the research and findings impartially.

## 7. Conclusion

The paper reported on the concept, implementation and findings of the qualitative research focused on the issue of career choice in primary and lower-secondary school. It explored lower-secondary school pupils' development in the learning process using the support of e-portfolio and cloud services in Technology lesson.

Based on the results of the recruitment process, the pupils carried out a self-reflection of their submitted work considering selected occupations and outcomes from the imaginary employer using an e-portfolio. Based on the research findings, we may confirm the presumption of a significant positive impact of using e-portfolios on the pupils' learning related to their preparation for choosing a career. The e-portfolio environment enables pupils to work with valuable information, which is also important for the development of their self-reflection and self-evaluation skills.

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# The Inclusion Potential of Student Production of Digital Learning Objects

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**Abstract**: This account of the inclusion potential of students' digital production is based on the large-scale research and development project *Students' Digital Production and Students as Learning Designers* (2013–2015), funded by the Danish Ministry of Education. The target groups were primary and lower-secondary schools. The project explored teacher-designed frameworks that engage students' agency as digital producers of learning objects for their peers. The findings indicate that digital production facilitates students' learning processes and qualifies their learning outcome when executed within a teacher-designed framework that accommodates and empowers students' agency. The Danish parliament passed the Law of Inclusion In 2012 with the objective that by 2015, 96% of all students would be included in normal classes. Inclusion was not part of the initial research agenda, but this changed unexpectedly during the project. Specifically, students who did not participate or participated only sporadically in everyday school activities at the beginning of the project adopted new positions as participants and agents. We understand these changes as inclusive processes initiated by the combination of teacher-designed frameworks, student agency and digital production. This paper describes two representative cases, analysed from a post-phenomenological perspective to explore the inclusive potential and role of digital artefacts and digital learning production. We found that 25 out of 50 student we at first identified as non-participants changed position during the project. We argue that both the learning design and the use of specific technological resources played a major role as actors in the observed emerging process of inclusion for both students and teachers.

**Keywords**: inclusion, exclusion, digital production, students as learning designers, actors, agency

## 1. Background

The project *Students' Digital Production and Students as Learning Designers* was one of five large-scale research and development *Demonstration School Projects*, representing the largest such effort initiated by the Danish Ministry of Education. Running from 2013 to 2015, the project involved a consortium of two universities, three university colleges and the LEGO foundation. Participants included 13 researchers, 40 teachers and 800 students; schools were chosen from a pool of applicants to reflect geographical and socio-economic dispersion.

The project built on our previous research findings, which challenged the consensus that design for learning lies exclusively within the teacher's domain, as even young students proved capable of engaging with design for learning, both reflectively and in practice (Sørensen and Levinsen, 2014; Sørensen and Levinsen, 2015). We also found that staging digital productions as learning objects aimed at peers had a positive impact on students' learning, as both process and product.

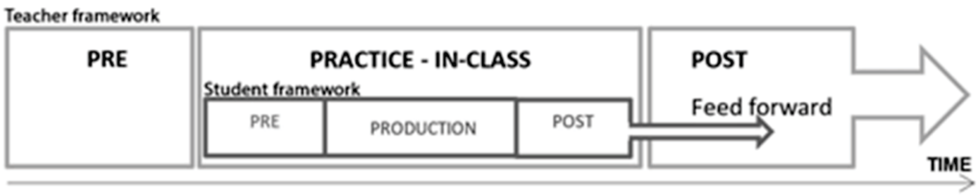


**Figure 1:** Chronology of the relationship between teacher's and students' work as learning designers

Building on this premise of design for learning as part of the students' domain, we created frameworks for six variously themed interventions involving student digital production. These productions encompassed a variety of multimodal forms, such as digital books, videos, blogs, robots and games. While some themes were subject-related (e.g. math stories, Danish digital storytelling, math games), others were cross-disciplinary (e.g. online collaboration on a given topic with other classes or schools, LEGO Mindstorm robot programming and Danish, explore your local environment and publish online). The interventions were informed by the following specifications.

- Complexity increases from intervention 1 to intervention 6—from simple productions to trans-disciplinary activities involving advanced technologies (e.g. social media, robotics, location-based technologies).

- The digital productions are learning objects aimed at peers.
- The interventions are integrated as everyday practices during the school year.

In each school, teachers developed and adapted the interventions and themes to their school's culture, producing their own learning designs in a collaborative process, with the researchers as sounding boards.

## 2. Data collection

The interventions ran over three semesters in first to second and fifth to sixth grades, and in two cohorts at a tenth grade centre. Because of the project's complexity, we used mixed methods to produce a complementary set of data for the interventions at both macro- and micro-levels (for details, see Levinsen et al 2014). The researchers followed one class from each school intensively at each level, following parallel classes extensively.

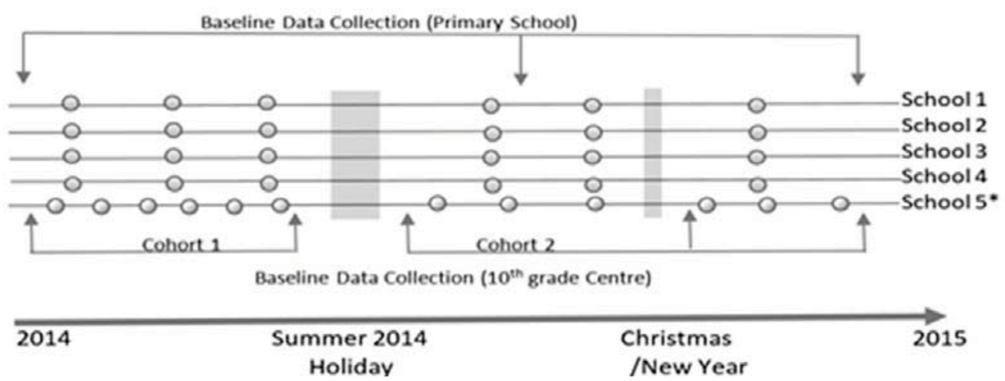


**Figure 2:** Distribution of the six interventions (circles) and baseline measures (arrows) over the project's life cycle. Note: As a 10th grade centre with two succeeding cohorts, 12 interventions and two sets of baseline measures, School 5* is an exceptional case

The mixed-methods research design comprised two data-collection strategies (Figure 2).

- Baseline measures at the beginning, middle and end of the project identified overall trajectories of transformation from a diachronic macro-perspective, using quantitative online surveys combined with qualitative structured observations.
- Longitudinal anthropological methods included thick description, informal and formal interviews with teachers and students, and reference to videos, photos, team meetings, material products and artefacts. The longitudinal macro-perspective identified changes in practices during and between interventions. The case-oriented micro-perspective identified transformations in individual students' and teachers' agency and practices.

## 3. Influence of the Danish Law of Inclusion

At the time of the project, inclusion was a hot issue in Denmark; the Law of Inclusion was passed by the parliament in 2012 with the goal that, by 2015, 96% of all students would be included in normal classes. The law was supported by massive digital investment but not by human resources. As Denmark was a signatory to the Salamanca Declaration in 1994, the political context revived an old discussion about whether "students with special needs and students who, for various reasons, cannot adjust to or function within the school ought to be included or excluded from the general school" (Petersen, 2015, authors' translation from Danish). The parliament decided on an inclusive strategy to be called *the spacious school*. However, inclusion turned into segregation; in 2010, 6% of a cohort was allocated to special offers, and the budget for special offers skyrocketed (Ministry of Education 2013). This situation led to the Law of Inclusion in 2012.

In terms of numbers, the law was successful but teachers found themselves professionally unable to deal with the wide spectrum of special needs students, and extra resources did not follow. This created massive pressures on schools, on individual included students and on their parents. In this process, students "who, for various reasons, cannot adjust to or function within the school" were to a large extent neglected. Following massive protests, the 96% measure was withdrawn in May 2016 (Ministry of Education, 2016).

The project took place at a time when conflict and debate about the Law of Inclusion and its consequences were at their highest. Although inclusion was not within the project's original scope, we were bound to notice and document incidents and actors that related to the issue of inclusion, as these affected both the realisation of interventions and our collaboration with teachers. We then began to notice that some students who had not previously participated appeared to change their position and engaged with the project. As these changes seemed to align with the idea of inclusion and at the same time related to the project, we decided to include these changes in the research in order to explore this unexpected potential for inclusion.

## 4. Student cases

Due to the Privacy Act (Datatilsynet 2015), we do not know how the students who did not participate in the beginning of the project related to the Law of Inclusion. For that reason, we could not distinguish between students with defined special needs and students who for some reason did not participate. Accordingly, we coded the thick descriptions of cases for person-related non-participating instances. The analysis showed about 50 students distributed across the five schools who appeared to be non-participating at the beginning of the project. Of these, we identified trajectories for 25 individual students, who can be divided into two clusters:

- students who changed from non-participation to (some degree of) participation during the project, coming to occupy new positions as agents in everyday activities as the classroom arena transformed; and
- students who were unable to change their position without external intervention; these students began to adopt new positions as teachers identified new options within the transformed classroom arena.

The cases described here, which follow two individuals, are representative of the two clusters. The case descriptions draw on the thick anthropological data and follow these students through interventions 1 to 6.

### 4.1 Jan changes his position

We followed Jan from fifth to sixth grade. He was an immigrant with limited spoken Danish-and almost no written Danish language skills. Teachers on the team referred to Jan as having weak resources and lacking motivation. In this sense, Jan was doubly excluded: by his language challenges, and by the teachers' negative expectations.

**Jan** Now we have read yours
**Susan** I write all the good things first and then the errors
**Jan** me too
**Susan** we think it is good with all the pictures
**Jan** we like you written when the Zoo is open and how much it costs
**Susan** your errors are that the names on page 1, 3 and 6. are not translated – you have written the Danish words
**Jan** UPS
**Susan** and there is almost no text. We think you should write more about the pictures and make headlines too.
Now, what are our errors?
**Jan** we should not write many text
**Susan** Why? Who said that?
**Jan** the (name of the teacher)
**Susan** Can we ask her?
**Jan** OK, and now your errors. Next time write bit more text
**Susan** Ok but why should we write more text when you do not have to????
**Jan** ask (name of the teacher)

**Figure 3:** Excerpt from online chat (authors' translation from Danish, including Jan's weak writing)

At the project's outset, most of what was going on appeared to escape Jan's attention. However, in the third intervention (math games), Jan was paired with a well-functioning girl. They managed to negotiate and test their design, but Jan became frustrated by his language limitations, speaking loud or turning away. The teacher failed to notice the level of collaboration, seeing only what he interpreted as aggressive behaviour. In the fourth intervention, the product was a tourist guide in English, aimed at the English friendship school. Jan was paired with a passive boy, and throughout the production period, the teacher ignored them. The teacher told the boys to produce a visual production with only a few written words but forgot to inform their peers. This created a conflict during an online chat-session (Figure 3) in which the groups provided peer-feedback. For Jan, this proved to be a turning point, as his effort to participate and contribute became visible to the teacher because of the other group's complaints. In the fifth intervention, Jan and another boy produced a multimodal instruction guide for a self-chosen Lego Mindstorms robot-programming task aimed at fifth graders. The teacher did not expect too much but supported and challenged their digital production. When the time came for the fifth graders' big test, Jan was very nervous. The fifth graders used the instruction, but the robot moved too far, leaving them puzzled. Jan suggested that it was not about the robot's speed but the length of time for which it was set to move forward. Together, they experimented and solved the problem.

> *It was fun to watch Jan today … because he was so sweet and patient with the fifth graders – he didn't say too much, but what he said was completely relevant. That is, he really thought about the relationship between speed and time – he managed to facilitate an experiment without taking over, and the next time the robot drove directly to that square. And … he cannot see it himself … he was just doing so well. (Excerpt from teacher interview (author's translation))*

At the end of sixth grade, the students work through self-evaluation. Jan wrote notes to himself about how he was doing well and how he needed to improve. He placed arrows in the evaluation circle to indicate the direction of progression. Most of the arrows point inwards, meaning "improvement". By now, he had caught up in the general subjects. He was fully included in everyday school activities and was considered a resourceful student. Although Jan now speaks Danish, he is still an insecure writer.

### 4.2 Peter—teacher-initiated intervention

Peter avoided grownups and eye contact and spoke only in single words. He sat at a remote table with another boy who did not participate. They played on the iPad and made inarticulate sounds. These boys represented the dilemma of the Law of Inclusion, as the teachers felt helpless. They referred to Peter as having weak resources, and they had no expectations at all for him. Like Jan, Peter was doubly excluded: self-excluded by avoiding all contact with adults, and further excluded by the teachers' lack of expectations. However, Peter did appear to be socially included at playtime.

In the first intervention, the teacher was a substitute who introduced the theme (digital production of math stories) in dialogue with the class. Peter and his partner went to their remote table, and to everyone's surprise, they produced simple math stories about erasers. During the peer evaluation, the boys tried a peer production but produced no feedback. When they received feedback on their own work, they giggled and made sounds. Following the first intervention, the original teachers returned, and Peter was again "parked" at the remote table until the fourth intervention (the English language tourist guide). Peter was paired with Zlatko, with whom he played computer games during breaks. Zlatko took the lead and insisted that they start working on the iPad. They found images from the Zoo and wrote simple text descriptions that Zlatko wanted them to speak aloud. Peter tossed an eraser in the air, but Zlatko grabbed it and put it away. He pointed at the screen: "*Come on, just say 'how', come on … you know you can do it … just say 'How do they feed (the animals in the Zoo)?'*" Peter repeated this for the recording. Zlatko pointed at the screen, and Peter tried to bite Zlatko's hand. Again, Zlatko said the words and Peter repeated them. The support teacher misinterpreted the collaboration, telling Zlatko not to distract Peter and moving him to another table while ignoring Peter. Peter grabbed a new eraser-man and tears off the head while making sounds, splitting it into tiny bits. This incident led to a discussion, initiated by the researcher, about the teacher-team's views of Peter and Zlatko. The teachers then decided to change their practice from ignoring or disciplining them to expressing expectations and facilitating their working process. During their continued collaboration, Peter began to speak: "*Where do they (the animals in the picture) live?*" He did this while pointing at the screen, although sitting with his back against the wall and as far from Zlatko as he could get. The boys ended up producing an acceptable iMovie tourist guide.

> *…. Then Peter tries to hide in the corner but Zlatko puts the iPad just in front of him. He doesn't get a chance to get away … and that's where I think that the digital … there is something there. Peter has participated and contributed, and Zlatko can hardly wait for their turn in the presentation round. Then the wireless cannot execute all the sounds, text and images … and they reduce the format ... They simply insist that we all see their product. You can discuss whether the subject objectives are present, but they have produced a product and they have worked hard; they have contributed, and they could accept the feedback from their peers. It was simple, but it was OK. (Excerpt from teacher interview)*

In the final intervention, second- and sixth-graders worked together to produce a 30-second video about a place in their local environment. Peter was given a special deal: he must not leave and he must contribute, but it is okay if he does not speak. The group chose Peter as the camera operator. As they worked on their video takes, Peter pointed to the paper storyboard and suggested potential positions, angles and distances using the iPad camera interface. He communicated using hand-signs and contributed by suggesting alternative takes and by pointing out details on the screen.

In the subsequent interview, the second graders said, "*It was a bit weird he didn't talk, but then we found out and it was okay".* They liked Peter and found that he produced good video in terms of composition, angle, distance and duration of the single shots. Similarly, the teachers said that Peter was involved and appeared to enjoy his new position: "*The others just talked to him as if he was talking and he was there from beginning to end … and the way he nonverbally communicated while they were doing their takes. He contributed to improving the quality"* (teacher interview)

## 5. Theoretical frame—a post-phenomenological perspective

As the scope of our research did not encompass inclusion as a strategy or phenomenon, we have chosen to focus on the inclusive potential of learning design and digital technology. The following is an account of the post-phenomenological perspective we used to analyse the two representative cases.

In his *Philosophy of Artefacts*, Verbeek (2005, p. 234) stressed that we should expand research about unspecified technologies and their *backwards* conditions of possibility for humans and the world. According to Verbeek, we should use both existential and hermeneutic perspectives to explore how relations between humans and specific technologies and artefacts *forwards* co-shape emerging experience and existence. In other words, research should focus on the entanglement of artefacts and humans; how humans are present in the world; and how the world becomes present to humans.

According to Heidegger (1967), when something (humans, artefacts, practices) are introduced to systems, they are *thrown-into-the-world* and marked with historicity. They act as disturbers that set the system in motion, initiating transformations that may materialise at various levels of the system: within relations and negotiations of meaning between human and non-human actors; in the organisational and structural co-shaping of arenas for agency; and in new artefacts (non-human actors). In return, these transformations mark the system with a historicity that becomes both constitutive of and constituted by the constantly emerging system (Barad, 2007, p. 172; Verbeek, 2005, p. 138).

For Verbeek, these changing marks of historicity have both hermeneutic and existential implications for how reality becomes present to humans in the form of phenomena (ibid, p. 112). In his exploration of these processes, Verbeek draws on Don Ihde's concept of mediation: how the presence of specific artefacts co-shapes and transforms human perceptions in terms of relations of mediation. According to Ihde (1978, p. 21), these relations perform within a structure of amplification/reduction, where every amplification implies a reduction of aspects of reality. Both Verbeek and Ihde reject the position that humans are alone at the centre of agency. Instead, they subscribe to the post-humanist position, which understands humans and non-human actors as mutually interdependent or entangled (Barad, 2007). However, in their understanding of human and non-human actors, they diverge from actor-network theory (ANT). According to ANT, there is no *a priori* distinction between actors, and they should therefore be treated symmetrically (Latour, 1996). In contrast, according to Ihde (Eason et al, 2003, p. 129), there is an *a priori* difference between human and non-human actors. Orlikowski (2005, p. 185) elaborates on how to balance a symmetrical approach with a distinction between types of actor, arguing that asymmetrical approaches may lose sight of intermingling relations while symmetrical approaches may neglect the differences between actors. To maintain the necessary perspective on both relations and actors, Orlikowski suggests the terms *human agency* and *material performativity.* She argues that these are interdependent and not given *a priori* but temporally emergent as phenomena in practice: "Human agency is always materially performed, just as material performances are always enacted by human agency" (ibid, p. 185).

Following Orlikowski, this approach enabled us to identify the unexpected and emerging conditions and consequences of temporal intertwining of students who, during the course of the project, unexpectedly emerged as partial or full participants in everyday practices from a position of non-participation—a process that can be characterised as a change from exclusion to inclusion. We adopt Orlikowski's position that while human and non-human actors differ *a priori* with respect to agency and performativity, the parts they play in the emerging agency cannot be determined *a priori*. With Verbeek, we consider how reality becomes present to participating actors in the entanglement of human agency and material performativity, which both Verbeek and Ihde characterise as mediation.

## 6. Analysis: Relations of mediation

Following Verbeek (2005, p. 221), Ihde provides a valuable framework for analysing how humans relate to the world, involving four basic forms of technological mediation. First, *embodiment relations* arise when technology is literally between humans and their world. Embodied artefacts become extensions of the human body that co-shape our relationship with our environment through their human-enacted material performance. In the present context, this applies to the various digital input and output devices and to learning-design practices. Second, *alterity relations* occur when we experience technology as a living being/quasi-other that may materially perform as either a helper or an opponent enacted by human agency. In our case, this applies to both learning design and technologies as drivers in communication and reflection processes. Ihde locates the third *hermeneutic relation* between embodiment and alterity, in which technology materially performs as a representation of reality. Through their agency, humans experience and interpret this as "something" in the world—in our case, for example, a map, a digital interface, a simulation or a specific learning-design practice. The fourth *background relation* blends into and co-shapes the context of our agency and perception. In general, the material performance of the background passes unnoticed as a co-shaper of human agency. As described, the four relations perform materially within a structure of amplification/reduction that co-shapes human experience, agency and perception of the world on a scale that ranges from certainty through probability to uncertainty regarding expected outcomes. In the enacted and emerging practice, everything is inseparable; only in the analysis can the researcher distinguish between actors, agency, performativity, experience, and so on as analytical constructs to reduce complexity and to operationalise "the empirical mess" (Hastrup, 1999, p. 154). In this way, Verbeek and Ihde provide an analytical approach to the intertwining of humans and technologies.

The cases reveal that both actors and their school bear marks of historicity that include the students' positioning as excluded and the negative expectations in the surrounding environment. The project introduced two new artefacts to this system: the learning-design framework (Figure 1) and the specific technological resources used for digital production. While these artefacts disturbed the system, historicity produced inertia because the actors needed time to unlearn previous practices and to adopt new ones. However, the transformations predicated on the research hypothesis slowly emerged (Sørensen and Levinsen, 2014) as the teachers' practices transformed from intermediary to facilitative, and time was re-allocated from primarily one-way communication to dialogue with students. Simultaneously, most students gained more control of their learning process and acted as learning designers. In short, while the learning-design framework transformed the arena for possible human agency and material performativity, specific digital artefacts transformed the arena for students' agency in terms of empowerment and means of expression.

Two unexpected clusters of students emerged from this process. In the case of Jan, students gradually transformed their position and teachers transformed their perceptions of Jan-like students. Peter's case highlights students around whom the teacher began to transform the context, shaping a new arena where Peter-like students transformed their perception of the school and of themselves at school. In both clusters, specific digital artefacts seemed to play an important role in these emergent transformations.

### 6.1 Learning design at work

In the first intervention involving Peter, the substitute teacher's lack of history with the class and his willingness to adopt the learning design co-created an arena in which Peter moved from his excluded position and delivered a digital production. This unexpected transformation was appreciated, but its potential for inclusion of Peter-like students went unrecognized by the teachers. In retrospect, however, this combination of learning design, teacher attitude and technology emphasized the robustness of the inclusive potential that gradually became a new mark of historicity, subsequently co-shaping new and more inclusive everyday school practices.

In the entangled emergence of transformations, the material performance of learning design as digital production mediated a hermeneutical relation with the teachers that amplified Jan-like students' efforts to participate and agential options for the teacher to apply contextual changes, inviting Peter-like students to break away from their self-exclusion. The transformation emerged in the way that teachers became present in the school through a new teacher position that was observant and facilitative, with a broader awareness of student practices.

At the same time, the material performance of learning design as digital production mediated embodiment relations that amplified a new repertoire of student agency by actualizing their informally acquired digital literacy and play practices (ibid). As materialized through the digital productions, the new repertoire of agencies amplified student competencies that both teachers and students found relevant in a school context. The learning design as digital production also mediated hermeneutical relations in terms of new ways of becoming present in school. These transformations materialized as a change in students' agency from passivity (waiting for teacher instructions or asking "What should we do now?") to empowerment (taking initiatives regarding digital production). In this way, mediation relations co-shaped a new and more positive perception of *school* and *being in school* for Jan-like and Peter-like students.

### 6.2 Technology at work

Prior to this project, technology was typically present in the form of educational instructional design aimed at training specific subject-related competencies (e.g. calculation and grammar), positioning students as reactive users and consumers. During the project, technologies became production resources for multimodal digital productions, repositioning the students as proactive participants and producers. One major finding was that the multimodal and intuitive digital interfaces materially performed as externalizers of otherwise invisible dimensions of the students' thinking and learning (ibid). For both students and teachers, the material performance of these externalizations mediated hermeneutical and alterity relations that amplified non-human actors as helpers and negotiators of meaning during the learning process.

For Jan-like students, the multimodal material performance of specific technologies amplified options for expressing themselves visually, in contrast to spoken or written language. As they already possessed basic operational and multimodal digital competencies, the technology mediated both embodied and hermeneutic relations that amplified the technology as an alterity relation and helping actor in their efforts to change position. In the fourth intervention, the teacher had organized a peer evaluation in the form of an online chat between two groups. Here, Jan drew upon his experience in writing chat messages. As he did not associate chatting with school and spelling correctly, Jan wrote as well as he could during the peer evaluation (Figure 3). Because of the other group's complaint about the teacher's different demands, the chat came to the teacher's attention. The chat materially performed the communication between the students and amplified Jan's efforts to participate and contribute, causing the teacher to change their perception of Jan. In this case, the chat performed a hermeneutic relation because the chat was not Jan's actual effort but a representation, which the teacher interpreted as Jan's effort. In this way, the hermeneutic relation co-shaped the teacher's perception of Jan and future practices involving Jan-like students.

In Peter's case, the teacher's awareness of changing the context around Peter was co-shaped by the new observant teacher position that amplified "cracks" in Peter's self-exclusive behaviour. Peter was good with computers and often constructed things at home. When he was finally freed from the teacher's demand that he speak, he exploited his embodied technological competence to enact material performances that produced new hermeneutic relations with his peers. As early as the first intervention, Peter broke out of his self-exclusion and managed to produce math stories because he did not have to speak. In the final intervention, Peter developed the sophisticated competence of co-shaping collaboration with a non-human helping actor, producing representations that externalized his unspoken utterances and hermeneutically mediated communication.

## 7. Conclusion

During this project, we found strong evidence that in engaging students as learning designers of digital multimodal productions, both the learning design and the use of specific technological resources played a major role as actors in the observed emerging process of inclusion. We also found that most students make an effort to participate, and that some of them (Jan-like students) work quite hard to change their positions. Additionally, we found that when students used digital resources for production, the hermeneutic mediation externalized and amplified their efforts. It therefore appears that teachers' lack of awareness regarding the student efforts to participate remains a dominant obstacle to inclusion.

In conclusion, we argue that the new observant teacher's position in relation to learning design and the use of technology co-constructed how students became present in school as participants in learning activities.

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# Designing an Object-Based Lesson Model Based on a Proposed Cloud e-Learning Framework

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**Abstract:** E-learning is persistently evolved in the adaptation of emerging technologies and pedagogies. The advancement and emergence of new technologies also empower continuous development of learning objects. Object-based learning approach has been widely adopted in e-learning. However, conventional object-based e-learning approach is insufficient to deliver the needs of upgraded learning processes especially in the higher education. The challenge of dealing with dynamic concurrency demands and rapid storage growth requirement especially in multimedia elements limits the flexibility and shareability of the e-learning content. The flexibility and on-demand access to a centralized shared pool of computing resources provided by Cloud computing enables high reusability and shareability, hence overcomes the issue in e-learning due to the rigidity of conventional object-based e-learning content. This paper describes a study on the design of an object-based lesson model based on a proposed Cloud e-learning framework. The proposed Cloud-based e-learning framework adopts the strengths of the current state of the art of Cloud learning frameworks. Principal to the design of the object-based lesson model is the development of Cloud-based e-learning objects where learners have the flexibility to access, personalize and deploy them in e-learning environment. With the availability of smart mobile technology and Web 2.0 tools, a new form of object-based e-learning utilizing Cloud technology is envisioned. Essential components such as Cloud-based e-learning object instructional properties and design principles are discussed. Cloud based e-learning objects being highly reusable and dynamically flexible, can be deemed as a new approach for knowledge aggregation.

**Keywords:** object-based e-learning, Cloud-based e-learning objects, e-learning, Cloud computing, flexibility, reusability

## 1. Introduction

The role of e-learning has significantly increased in recent years as new digital technologies emerged rapidly. World Wide Web has been extensively used as an intermediate for displaying and delivering teaching material, leveraging the Web visual environment and interactive nature. Educational and technological aspects are becoming progressively important facets in e-learning content development. To enable the acquisition of knowledge in a more effective, efficient and appealing manner, innovative e-learning pedagogies are continuously devised and facilitated.

Conventional e-learning methods are definitely insufficient to deliver the needs of the unceasing upgrading in e-learning processes especially in higher education (Wang, Lau, Lew, & Leow, 2015). The great demand for e-learning content especially multimedia element requires rapid storage growth and dynamic concurrency demands, which is not sufficient to be handled by the conventional e-learning methods. The production of multimedia e-learning content is time-consuming and costly; therefore take advantage of the reusability and shareability of the e-learning content is necessary for optimized production. For the objective of reusability, object-based learning approach has been widely adopted in e-learning. Holding the properties of being smaller, self-contained, reusable units of learning, aggregated, and tagged with metadata, object-based learning provides an effective way of learning in some ways. However, the existing object-based learning approach does not optimize the shareability of the e-learning content. Rigidity of learning content limits its reusability and shareability.

The emergence of Cloud computing provides a significant breakthrough and has gained considerable acceptance in e-learning landscape. Cloud computing is evolving as a key technology for resource sharing (Kalagiakos & Karampelas, 2011). The flexibility and on-demand access to a centralized shared pool of computing resources provided by Cloud computing enables high reusability and shareability, hence overcomes the issue in e-learning due to the rigidity of conventional object-based learning content. Possessing the capabilities of distributing computation and IT capabilities of services, Cloud computing is a favorable infrastructure which is able to deliver notable values to teaching and learning landscape (Dong, Zheng, Yang, Li, & Qiao, 2009).

Cloud computing provides services in term of infrastructure and software (IaaS and SaaS) on a simple-pay-per-use basis (Sulistio, Reich, & Doelitzscher, 2009). The crucial element of Cloud computing is its component-based nature, such as reusability, substitutability, extensibility, customizability and scalability (Vouk, Averritt, Bugaev, Kurth, Peeler, Schaffer, Sills, Stein, & Thompson, 2008). Cloud computing has been used to support cooperative learning and remote e-learning based on Cloud computing environment and the transformation of computer fundamental curriculum in universities (Lin, 2011). Services provided by Cloud computing can shape a new education domain that shares the Cloud characteristics of elasticity, flexibility, efficiency and reliability (Gong, Liu, Zhang, Chen, & Gong, 2010)

This paper describes a study on the design of an object-based lesson based on a proposed Cloud e-learning framework. Principal to the design of the object-based lesson is the development of Cloud-based e-learning objects where learners have the flexibility to access, personalize and deploy them in e-learning environment. The Cloud-based e-learning objects are then being combined to form larger educational interactions. With the availability of smart mobile technology and Web 2.0 tools, a new form of object-based e-learning utilizing Cloud technology is envisioned. Cloud-based e-learning objects are highly adaptable, reusable and easy changeable, hence allowing them to be used dynamically with greater customizability and flexibility in e-learning. Essential components such as Cloud-based e-learning object instructional properties and design principles, definition and implementation principles of object-based lesson in Cloud-based e-learning environment are also discussed.

## 2. Proposed Cloud-based e-learning framework

In recent years, numerous Cloud frameworks have been presented and discussed in various literatures. A few notable frameworks such as CloudIA (Sulistio et al., 2009), BlueSky (Dong, Zheng, Qiao, Shu, & Yang, 2009), EUHC (Saidhbi, 2012), Academic Cloud (Madhumathi & Ganapathy, 2013), CEL (Kaur & Chawla, 2014), etc. offer various benefits to their audiences by adapting Cloud computing in e-learning infrastructure. Adopting the strengths of the mentioned Cloud frameworks, a Cloud-based e-learning framework is proposed for formation of a new education domain that shares the Cloud characteristics particularly reusability and shareability.

The proposed Cloud-based e-learning framework, illustrated in Figure 1, is composed of five layers, which are User Interface Layer, Application layer, Cloud Management Layer, Data Information Layer, and Virtual Infrastructure Layer. Each layer in the framework consists of various components. User Interface Layer acts as interface between learners and Cloud infrastructure. Learners can converse with the Cloud using browser enabled devices such as desktop computers, laptops and mobile devices. Since Cloud-based e-learning objects are embedded and located in the Cloud, web browser provides a path for learners to access them. Application Layer consists of e-learning systems, content repository and learning tools. E-learning system provides functions and interaction interfaces for learners to acquire knowledge and information. For learning tools, various Cloud tools and Web 2.0 can be adopted. The emergence and advancement of Web 2.0 stimulates the evolvement of traditional Internet from mass media to social media. Web 2.0 allows online applications to be delivered via web browsers. Through remarkable application interfaces, pre-built application services or widgets, the interactions between applications and users are greatly improved.

Cloud Management Layer maintains and manages resources of the e-learning infrastructure by the means of four components namely Provision Manager, Common Services, Load Balancing, and Monitoring. Provision Manager manages the execution of resource allocation by deploying resources to learners automatically in a short time. Monitoring component keeps track of the execution of requests, the real-time configuration information and resource utilization levels to verify if the QoS objectives are met across all the layers of the Cloud framework. Data Information Layer mainly contains e-learning content. The proposed Cloud-based e-learning objects are located and managed by this layer. Virtual Infrastructure Layer enhances the transparency of hardware by virtualization, and realizes resources handling. There are two components in this layer namely Virtual Storages and Machines, and Physical Hardware. The proposed Cloud-based e-learning framework utilizes Cloud technology in order to use learning resources more effectively and also to adopt Cloud characteristics.

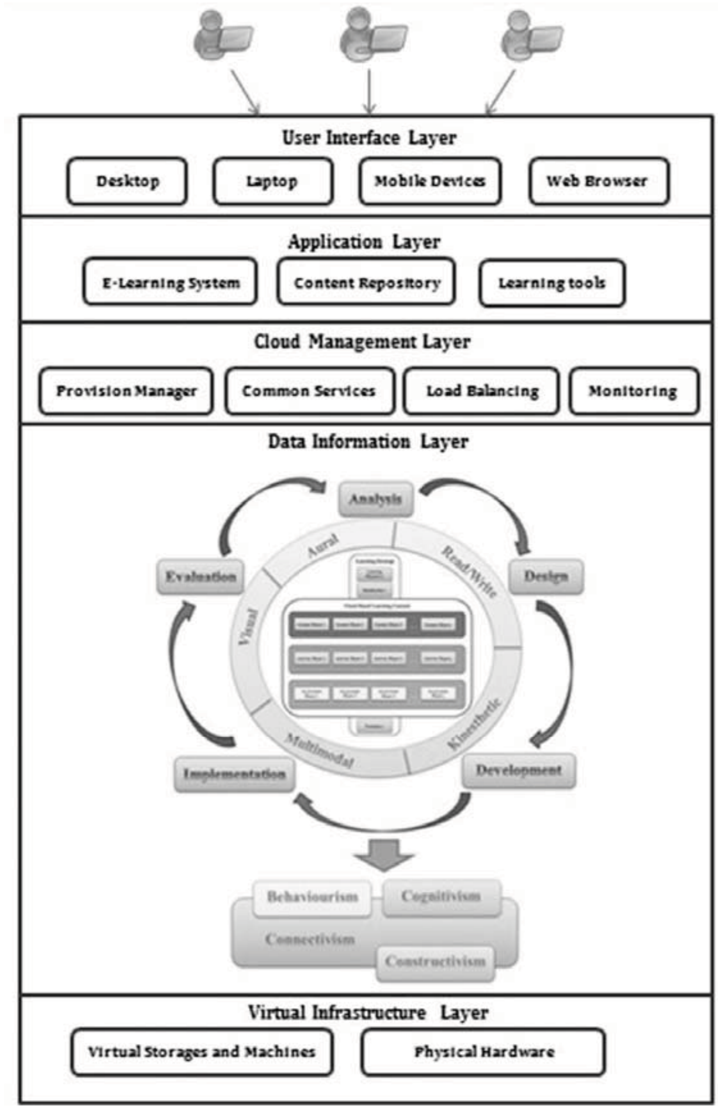


**Figure 1:** Proposed Cloud-based e-learning framework (overall)

## 3. Cloud-based e-learning objects

Over the years, the evolvement of learning objects can be observed in terms of methods, standards and technologies (Fiaidhi, 2011). The next generation learning objects are bundle and Cloud-oriented which is why the Cloud-based e-learning objects are proposed and designed. Ever since the concept of learning objects was presented by R. W. Gerard (Gerard, 1969), a number of learning models adopting learning objects have been developed. A new paradigm in learning landscape is driven by the advancement of learning objects. Instead of the traditional "several hour chunk", they provide smaller, self-contained, reusable units of learning (Beck, 2001). Learning objects can be gathered, employed and reused from a variety of sources to produce a sound object-based lesson or course structure in different contexts (Polsani, 2003). Standards and specifications of learning objects have been defined and accredited by several groups, namely IEEE Learning Technology Standards Committee, Advanced Distributed Learning Initiative, Instructional Management System Global Learning Consortium and Aviation Industry Computer-based Training Committee. A well-defined learning object should be reusable, accessible, discoverable and manageable.

Object-based learning approach has been widely adopted in e-learning. The advancement and emergence of new technologies empower continuous development of e-learning objects. Recently, Cloud computing has become one of the emerging technologies that can transform and restructure the learning landscape. Various Cloud tools have been developed and made available online. Cloud computing empowers new approach of processing, integrating and consuming information. The most important functionality of Cloud-based e-learning objects is the flexibility of being reused and shared to learners.

Cloud-based e-learning objects embed Cloud characteristics for a more comprehensive specification. With the readiness of Cloud infrastructures for collaboration and wide accessibility such as Web 2.0 tools, the development of redefining learning objects to suit e-learning in Cloud environment is imperative. Utilizing various Cloud and Web 2.0 tools, Cloud-based e-learning objects can be easily created. For instance, Powtoon is Cloud-based software (Saas) for creating animated presentation and videos in a much easier manner. Prezi, being another Cloud tool, enables amazing non-linear presentations on the web. Besides that, Cloud-based e-learning objects can also be personalized and edited based on personal needs of learning. Cloud based e-learning objects are stored in the Cloud and can be easily shared and published via various tools and social media such as Screencast, YouTube, etc. One of Cloud characteristics – scalability can be observed in Cloud-based e-learning objects as the size and resolution of the learning objects can be adjusted easily to suit the device specifications and internet speed. Nonetheless, the resolution of 16:9 is the universally accepted standard aspect ratio. Besides that, the aspect ratios of 1.85:1 and 2.39:1 are also suitable for video deployment (Jerron, 2012). Nowadays, hashtag has gained its widespread use as a type of label or metadata tag on social networks for the ease of finding messages with a specific theme or content. Utilizing hashtag as a metadata tag in Cloud-based e-learning objects enables the content to be easily searchable by potential learners.

Different perspectives on the justification of learning object duration has been discussed in several literatures. Neeraja in her e-book (Neeraja, 2011) suggested that duration of 5 -10 minutes is optimum for a normal learner to achieve the simplified learning objective. The exact duration differs based on types of learners in terms of fast and slow paced. The justification is related to educational psychology where human memory system or brain is involved. In the study of educational psychology, information only survives in memory for about 0.5 to 2.0 seconds (Gredler, 2008), therefore it is crucial to actively select information in the short-term memory for further processing so that the information can be migrated to long-term memory. A learning duration more than 10 minutes significantly diminish the attention and motivation of learning. Hence, the ideal duration of Cloud-based e-learning objects is 5-10 minutes for optimum learning.

## 4. Object-based lesson model

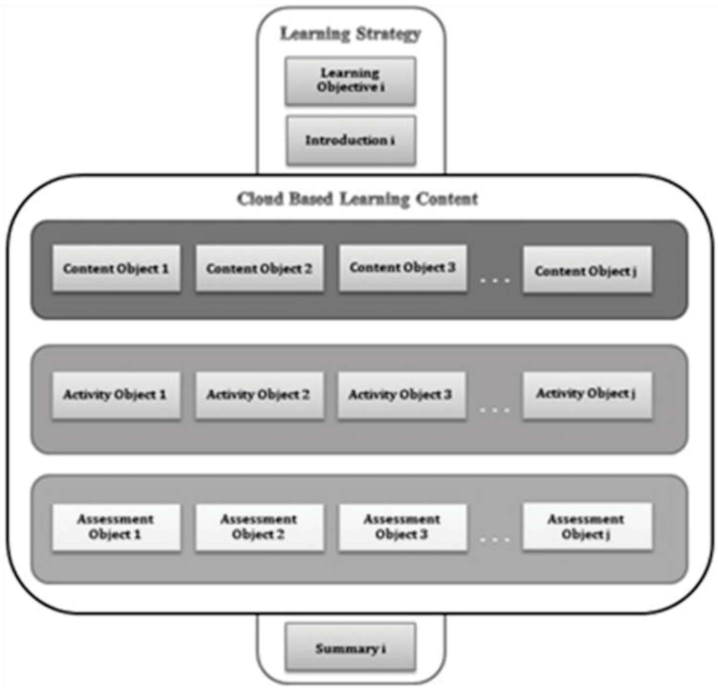


**Figure 2**: Object-based lesson model

Based on the proposed Cloud-based e-learning framework, an object-based lesson is designed in the principal of Cloud-based e-learning objects, as presented in Figure 3. The object-based lesson model, as shown in Figure 2, has two main components: Learning Strategy Component and Cloud Based Learning Content Component. There are three main elements namely Learning Objective, Introduction and Summary in Learning Strategy Component. These three elements are designed and incorporated into every e-learning lesson to produce a comprehensive instructional experience. Learning Strategy Component gives an overview of the lesson from beginning to end, with the learning objective as the hub of the lesson. Learning objective describes the anticipated instructional outcomes after the learners have experienced the Cloud-based e-learning objects. It allows learners to begin learning with the end in mind. As the name implies, the introduction and summary introduce and review content at the beginning and the end of the lesson respectively (Lau, 2002a). For each of these elements, Cloud-based e-learning objects should focus on a specific learning objective, so that it is small and discrete enough to support flexible and personalized learning.

The Cloud Based Learning Content Component comprises Content, Activity and Assessment, which are the main elements used by the learners to achieve the learning objectives. The Content object is the core module that supports knowledge acquisition, performance enhancement or behavioral revolution associated with the learning objectives. Cloud-based e-learning objects can be created using Cloud content creation tools such as Powtoon, Prezi, Mind mapping tools, EdPuzzle, etc. Based on one of the specifications of Cloud-based e-learning objects, each content object shall be tagged with metadata tags or hashtags so that the learning object can be shared, accessed and discovered, and eventually reused widely across learning environments. Universal sharing of the e-learning object is believed to be able to be achieved if the object is labeled or tagged properly. There are five learning styles, namely visual, aural, read/write, kinesthetic and multimodal, which is the combination of two or more learning styles. In order to accommodate various learner needs, each Content object is designed with at least three presentation formats. The presentation can be in the form of text, video and audio, or combination of any two. Majority of learners learn better when the learning content is in two or more forms, for instance, video with captions. To optimize learning, learning content object shall be within 5-10 minutes duration.

Activity object allows learners to perform certain tasks related to the learning objectives and to obtain feedback on their performance. Activity object can be in the form of game, application, etc. Activity creation can be done with a Cloud tool called Scratch, where interactive stories, games and animations can be created. Kinesthetic learning style can be observed with game activities. Learners will have the chance for remediation if necessary while performing the activities.

Assessment object presents learner with some challenging situations, scenarios, or questions. The results obtained by learners in the assessment closely estimate what the anticipated result is like on the e-learning. As such, learners can be evaluated on their memories on certain theories using multiple choice questions. Cloud-based e-learning objects for assessment can be created using interactive Web 2.0 tools such as Kahoot, Quizizz, etc. The fun and interesting assessment objects will be able to attract learners to participate and learn optimally. However, although multiple choice question assessment method is commonly used, it may not be suitable to certain field of study, and therefore appropriate assessment methods shall be considered according to the nature of study. In order to determine if the learners understand certain processes, an interactive simulation can be deployed. Depending on the level of difficulty associated with the content based on Bloom’s Taxonomy, combinations of assessments can be used to help the learners understand the skills or key concepts (Lau, 2002b).

In the process of designing object-based lesson model, a decent instructional design ensures a sound and effective instructional lesson. Being the very core of instructional design and the basis of instructional systems design (ISD), ADDIE instructional design model is considered in the lesson design. ADDIE model represents a dynamic and descriptive guideline in five cyclical phases – Analysis, Design, Development, Implementation and Evaluation.

Instructional learning theories also play crucial role in the design of object-based lesson. Learning theories namely behaviorism, constructivism, cognitivism and connectivism help shape and define the outcome of object-based lesson. Driven by the advancement of technology, digital media and the Internet, the learning theories have been constantly re-evaluated and enhanced. In the present digital age where significant changes take place in the trends of learning, Connectivism, also known as a digital age learning theory, which is being developed by two Canadian educators, George Siemens and Steven Downes (Siemens, 2005), is worth mentioning. Connectivism is a learning theory that recognizes that in a networked world the way that information is created, distributed, processed and evaluated plays a significant role in the learning process. A thorough discussion on the debate over whether connectivism is a learning theory or instructional theory or merely a pedagogical view has been presented (Duke, Harper, & Johnston, 2013).

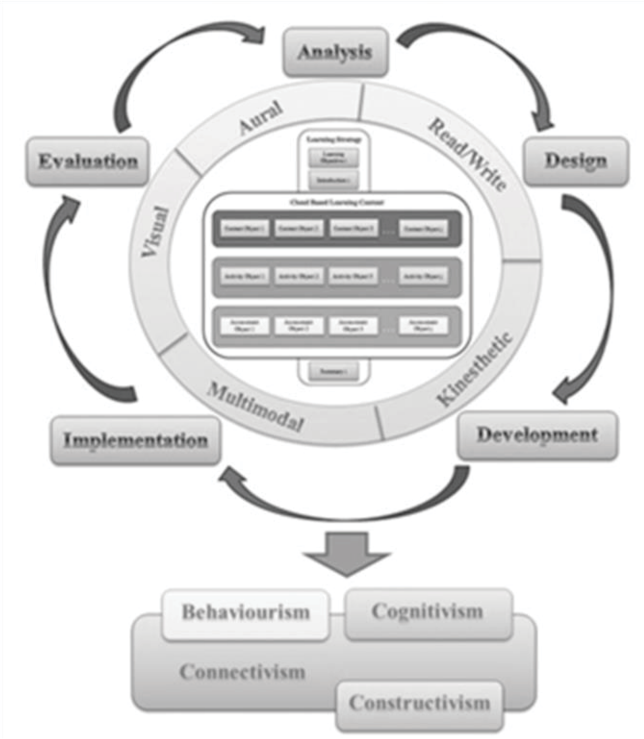


**Figure 3**: Design of object-based lesson in the principle of Cloud-based e-learning objects

## 5. Conclusions

Despite of the readiness of Cloud infrastructures for collaboration and wide accessibility such as Web 2.0 tools, the development of redefining learning objects to suit e-learning in Cloud environment is not encouraging. Up till now, there has been rather little activity being carried out to ensure that e-learning applications are being designed in such a way that promote flexibility and shareability of the learning content. This paper has discussed the design of an object-based lesson based on a proposed Cloud e-learning framework. Principal to the design of the object-based lesson is the development of Cloud-based e-learning objects where learners have the flexibility to access, personalize and deploy them in e-learning environment. The Cloud-based e-learning objects are then being combined to form larger educational interactions. Cloud-based e-learning objects are highly adaptable, reusable and easy changeable, hence allowing them to be used dynamically with greater customizability and flexibility in e-learning.

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# Biometric Belt and Braces for Authentication in Distance Education

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**Abstract:** Assessment of students in higher education has a tradition of using mechanisms to prevent cheating and plagiarism, and the same need exists today for online assessment in virtual learning platforms. The number of students that are suspended from courses in tertiary education has increased in the last decade and there is a need for new techniques to handle the problem in online environments. To achieve zero cheating is hard (or impossible) without repelling not only cheaters but also those students who do not cheat, and a zero-tolerance emphasis would also risk inhibiting students' intrinsic motivation. Several studies indicate that existing virtual learning environments do not provide the features needed to ensure that the intended student is the one taking the online exam. New technology opens up opportunities for online authentication through biometrics, but raises new ethical issues in the fields of integrity and data protection. The aim of this study is to explore and discuss how a reliable model for online authentication in distance education could be constructed with the use of biometrics without the risk of unnecessary integrity violation. Data has been collected in a literature study and discussed in the light of existing technology applied to the field. Findings show that promising digital techniques exist which could be combined to assure authentication in online exams without violating students' privacy or storing sensitive data. A suggestion is to develop a biometric belt and braces model with a combination of scanned facial coordinates and voice recognition, where only a minimum of biometric data is stored. Conclusions are that online examination becomes feasible when the associated cheat risks are not zero but as low as in traditional examination, and that students' integrity have to be considered in all learning modalities.

**Keywords:** online authentication, biometrics, distance education, online assessment, elearning integrity

## 1. Introduction

Identification and authentication are important issues in online education as well as in more traditional face-to-face examination (Furnell et al, 1998; Mardanian and Mozelius, 2011; Ullah, Xiao and Lilley, 2012). Cheating in educational contexts can be divided into unintentional and intentional cheating where the intentionally cheating students make plans in advance. Examples of planned cheating are to use Internet connections or text messaging during exams or to sneak hidden notes into exams (Sewell, Frith and Colvin, 2010). However, to completely reduce cheating is hard or likely impossible without repelling not only cheaters, but also all other students. A zero-tolerance emphasis on cheating would also shift the focus from learning to test scores, with a risk to destroy students' intrinsic motivation. Test scores are mainly meaningful within the educational context, while the actual learning outcome is what creates meaning outside of the education and after a course is completed.

Biometrics is an emerging field that opens up new opportunities for online authentication (Hernández et al, 2008), but with side effects that also raise new ethical issues of integrity and data protection. Biometric systems based on the digitisation of various physiological criteria has been widely discussed in research during the last 30 years (Alexandre, 1997; Jain, Bolle and Pankanti, 2006). In this study the aim is to explore and discuss how a reliable model for online authentication might be constructed with the use of biometrics without risking unnecessary integrity violation of distance students.

### 1.1 Research question

How could a reliable model for authentication in two-way real-time video based examination be constructed, with the use of biometrics and without risking unnecessary integrity violation?

## 2. Related research

### 2.1 Cheating in academic education

As shown in studies from before the era of Internet distance education, cheating while participating in higher education is not a new phenomenon. A large-scale study involving over 5000 students from 99 colleges and universities in the USA found that three quarters of the participants had engaged in cheating during their education at one or more occasions (Bowers, 1964, from McCabe et al, 2001). Data obtained in 1990-1991 showed that two thirds of the students participating in a survey had engaged in questionable academic behaviours as defined in that study (McCabe and Trevino, 1993).

Regarding specific types of cheating, Haines et al (1986) have reported cheating during traditional (physical presence) exams by 23% of the participating students, in comparison to 34% having cheated on assignments. This corroborates earlier data where 26% of the participants had copied from another student during a test, and 30% had plagiarised in their written work to be handed in (Bowers, 1964, from McCabe and Trevino, 1996).

In a longitudinal view the general trend in higher education cheating is an increase, although there are exceptions regarding certain types of cheating. Comparing data from (Bowers, 1964) and (McCabe and Trevino, 1993) shows an increase from 26% to 52% of the participating students who had cheated by copying from another student during an exam, and an increase from 16% to 27% of the students having used unpermitted crib notes during an exam. A change in the opposite direction is shown regarding plagiarising written work, which had decreased at least slightly from 30% to 26% of the students. It is interesting to note however that unauthorized collaboration on assignments requiring individual work had increased from 11% to 49% of the students over the years.

Reasons reported for cheating in academic education include immaturity, lack of commitment, and neutralisation (Haines et al, 1986), the latter allowing the cheater to maintain a clear conscience by rationalising undesirable behaviour as excused under certain circumstances (Sykes and Matza, 1957). A review of 107 studies on college cheating found that the strongest correlations to cheating included variables such as studying under poor conditions, having moderate expectations of success, anticipating a large reward for success, and perceiving that social norms support cheating (Whitley, 1998).

Specifically targeting online education, a study was performed in 2002 at a large, undisclosed public American university. With a sample size of 555 students and using a randomised response survey to protect participant anonymity, results indicate cheating by less than 4% of the students (Grijalva et al, 2006). It should be noted that this figure refer to a single class/course, while the previously discussed figures regarding cheating in traditional settings refer to a student's total time in higher education, making a direct comparison impossible.

However, a study by Kerkvliet and Sigmund that focused on a single traditional class setting indicated that between 1.9% and 13% of the students (depending on if direct response questionnaires or randomised response questionnaires were used) cheated (Kerkvliet and Sigmund 1999). In comparison with these results, the results from the (Grijalva et al, 2006) study indicate that cheating in an online academic course is not greater than in a comparable traditionally set academic course.

## 2.2 Academies' prevention of dishonesty

One approach to prevent student's dishonesty is the university code of honour. This is a set of rules describing what actions are not permitted and the consequences for students taking such actions. Another way of preventing cheating is the use of proctors during written exams. Even while using such codes of honour and proctors, universities still have found many students to cheat.

Haines, Diekhoff, LaBeff and Clark (1986) have studied the concept of neutralisation originally suggested by Sykes and Matza (1957). Neutralisation is the phenomenon when a person rationalises his or her dishonest behaviour with arguments like “I can do this because the work load within this course is just too overwhelming” or “I can do this because I have a half-time job on the side which gives me less study time than the other students have”. By doing so the student puts the blame for cheating on external factors rather than on himself, and also protects himself from the blame of others (Haines et al 1986). This neutralises the behavior in the sense that the person's feelings of shame are reduced or even eliminated. Haines et al (1986) compared the concept of neutralisation between cheating and non-cheating students. A total of 380 undergraduate students at a small university in southwest USA participated in this study. Results showed that 54.1 percent of the students reported having cheated. Further, age or maturity, being single and having low grade-point averages (GPA) were common factors among those students having a neutralisation attitude. Also, these students were found to be more concerned with the punishment than with the immorality of the act. Thus, neutralising students regard the utility of cheating in favor of the possible punishment (Haines et al 1986).

Shu, Gino and Bazerman (2011) found that participants reported lower moral disengagement when considering the dishonesty of others than when considering their own. This might be due to use of neutralisation. Further, they found that the opportunity to cheat and the awareness of ethical standards influence moral disengagement. Simply asking participants to read a code of honour when they had the opportunity to cheat reduced dishonesty. Also whether one signed the code of honour or just read it influenced cheating. The Shu et al (2011) study suggests that opportunity and knowledge of ethical standards are two factors that impact students' ethical decision about cheating. This is in line with the results in (McCabe, Trevino and Butterfield 2001), showing that if students regularly are reminded of the university's code of honour, they are less likely to cheat.

For an online course setting, Gearhart (2001) suggest that teachers should develop a guideline for "good practices". Gearhart suggest that it is critical to provide learners with information – about the academic ethical policies – over and over again by spelling out this information in all areas of concern in the online learning environment. This is in line with the (McCabe et al, 2001) result that regularly reminding students of ethical practices reduce the likeliness of cheating. Based on the results from (Haines et al, 1986; Sykes and Matza, 1957; Shu et al, 2011; McCabe et al, 2001; and Gearhart, 2001) it is clear that there may never be a situation where zero students cheat.

## 2.3 Identification and authentication

To associate an identity with an individual is called personal identification which consists of the two subproblems of identification/recognition and authentication/verification. The first problem of identification is related to the establishment of a subject's identity (Who am I?) while authentication refers to the problem of confirming or denying a claimed identity (Am I who I claim I am?). (Jain, Bolle and Pankanti, 2006) In traditional examination authentication has mainly been based on social security numbers and ID cards/passports, considered to be a reasonable secure process if combined with face-to-face supervision.

In online examination there are reports of students hiring other persons to increase their scores (Flior and Kowalski, 2010) and there is a need for new enhanced authentication tools (Ullah, Xiao and Lilley, 2012). For companies and Internet environments the process of authentication is often completed through the use of logon identification with passwords and the assumption of the password to guarantee that the user is authentic (Ramzan, 2007), but logins and passwords can be borrowed (Bailie and Jortberg, 2009). The discussion on how to provide enhanced authentication in online examination has led to many suggested solutions; four of them are:

- Challenge Questions: with questions based on third-party data
- Face-to-Face Proctored Exam: with government or institution issued identification
- Web Video Conference Proctor: audio and video conference proctoring via webcam and screen monitoring service with live, certified proctors
- Biometrics and Web Video Recording: with unique biometrics combined with the recording of student in exam via webcam

(Bailie and Jortberg, 2009)

In this article there is a focus on the fourth idea combining biometrics and web video recordings.

## 2.4 Biometrics and ethics

Three types of digital biometrics for individual identification that have been explored are fingerprints (Fishbine, Withoff, and Klein, 1995), voice recognition (Muda, Begam and Elamvazuthi, 2010) and handwritten signature (Feng and Choong Wah, 2002). What they have in common is that they all are possible to replicate, and also depending on large storage space and processing.  A biometric system that is more difficult to copy is the so called keyboard biometrics or typing biometrics where the biometric identification is based on computer users' unique typing patterns and keyboard behaviours (Alexandre, 1997).

Researchers like Jain, Bolle and Pankanti (2006) claim that it is biometrics only that can recognise you as you. But the research discussion on biometrics that initially had a focus on cost efficiency has also started to bring up the issue of ethical considerations. A careless use of biometrics could provide data and methods for unwanted identification that might endanger unwanted identification (Jain, Bolle and Pankanti, 2006). The Italian philosopher Giorgio Agamben has compared the data collection in the US biometric database, that is used to check visitors before entering the country, to what the Nazis did during World War II (Mordini and Ottolini, 2007).

## 3. Belt and braces for authentication

### 3.1 A model for video based real-time online examination

An idea for online courses is that assessment should not only be a one way process where the students get grades and feedback. The examination process should also be a channel for students' feedback to teachers and course instructors (Mardanian and Mozelius, 2011). New online methods could be combined with traditional assessment in an array of techniques aligned to the learning outcomes (Runyon and Von Holzen, 2005).

Examples of summative and formative assessment in an online course could be a mix of:

- Multiple choice questions (MCQ) tests, automatically corrected in a virtual learning environment
- Term papers or essays analysed by the course instructors
- Individual or group assignments posted in digital drop-boxes
- Oral or written tests conducted in the presence of the instructor or through videoconferences

(Dikli, 2003)

Authentication problems related to MCQ tests and essays have been widely discussed. The model presented here, tested by one of the authors, is to have assignments posted in drop-boxes analysed and discussed in online video seminars. This assessment process consists of the following steps as outlined in (Mardanian and Mozelius, 2011):

- The first step to present their projects is to book a presentation time in a wiki which contains a table of available time slots on specific dates and times. Students can here easily pick a time slot and register their names for their presentation.
- Before presenting their final projects, students should make sure they have the required Internet connection bandwidth to be able to use online video conferencing software without interrupts and disconnection.
- Video conferencing requires equipment such as a web camera and a microphone to be able to interact with the teacher, show their id card and present their project. Most modern portable computers have a web camera, speakers and a microphone. In case students miss one or more of these devices, they can borrow it from the university, and the device will be sent to their home address without any fees if it is returned in good condition.
- The recommended software to be used for online seminars is *Skype* which students can download for free. It is recommended that students install, test and customise the software before their presentation.
- To verify the students' identity they need to show their passport or a identification card to the teacher during the online seminar.
- Students' submitted project solution are presented and discussed during 20 minutes.

The real-time online seminar starts when the teacher sends a short message to the student that has booked the presentation slot for his/her presentation checking if the student is online and ready to present. When the teacher gets an approval from the contacted student the teacher sends a video call. The duration of a seminar is 20 minutes for each of the students with 10 minutes for presenting the submitted software application followed by 10 minutes for questions and discussions about project details. During the latter 10 minutes the teacher asks more specific questions about design and techniques where students have to answer and defend their solution to ensure that the actual assignment solution has been developed by the students themselves. (Mardanian and Mozelius, 2011)

Real-time here means that the video is sent live, with built-in lag of processors and networks. With two-way real time video, communication (or interaction) is possible between two users, here the student and the examiner. Examination based on two-way real-time video means that the examiner and the student could see and hear each other well enough for a dialogue to take place.

### 3.2 Scanning and storing biometrics without violating personal integrity

Different types of biometrics have different grades of uniqueness and permanence, where the frequently used fingerprints, iris patterns and DNA all have high uniqueness as well as high permanence (Jain, Bolle and Pankanti, 2006). At the same time it can be posit that all of these three also have a high potential for misuse and integrity violation. Furthermore, they all need considerable space if stored in a database for all students in a country.

There are also different decisions taken in different countries regarding the appropriateness of storing biometrics. Germany has earlier not allowed collection of biometric data, while India has decided to gather biometrics of all ten fingers, combined with an iris scan of the eyes as well as a photo of the face, as identifiers of all residents (Chowdhury, 2011). The non-restricted Indian model would probably entail integrity issues in Germany (ibid.), but the German *ePass* contains a chip that holds a digital photograph and one fingerprint from each hand. As found in a study by Schimke et al (2004) there are cross cultural integrity issues in a global storage of biometrics.

Instead of risking to violate students' integrity, authors would like to suggest a model based on biometrics with less risk of misuse. The basic idea is to use biometrics with a medium to low grade of uniqueness and permanence, with low risk of integrity violation, but secure enough for authentication in online courses if two types of biometrics are combined. This combination should be facial coordinates and voice recognition, two types of biometrics that also are seen to have high acceptability (Jain, Bolle and Pankanti, 2006). Furthermore, face recognition that only stores coordinates and not images would require little storage space. However, the main reason for only using the coordinates for facial parts is that there is a minimum risk of data abuse.

## 4. Discussion and ethical considerations

Biometrics and its storing raises new ethical concerns and besides the issues of integrity, privacy, and data protection we also want to mention the importance of the principle of informed consent that has been brought up in research by Sutrop and Laas-Mikko (2012). The Indian model of storing biometrics with high uniqueness and high permanency would certainly provide trustable authentication, but not without risks of integrity violation. There also seems to exist a need to further explore the risks of social exclusion resulting from the use of biometrics data (Wickins, 2007).

Beyond the issues of integrity are the issues of relevance and ethics of authentication related to learning. The need to prevent cheating and plagiarism presupposes the existence of rules. In the case of examination, rules have been created in order to certify that a test measures what is supposed to be measured, i.e. the validity of data. To put it differently, a test should measure what each student has learned but to do tests (and follow-up tests) is time-consuming. Multiple-choice testing can assess what is easy to test, which can be relevant to a certain degree (e.g. diagnostics) but not as the only metric for high-stakes purposes (Ravitch, 2011) and not for assessing knowledge and skills that go beyond facts. These limitations reduce the value of testing and therefore also reduce the need of authentication.

If the collected test data is still used beyond its inherent limitations, the data is invalid regardless of whether authentication worked or not. The value of testing is then questioned: testing for the sake of testing, which can be described with the words of the philosopher Bernard Suits: A justification for unnecessary rules can be called “the bureaucratic justification; that is, no justification at all.” (Suits, 2005 p.53). It would be like gaming the system, where the system is manipulated to suit the needs of the school or the teacher. Ravitch (2011) explains that some teachers even change test results to get better scores in evaluations of their work, which renders another dimension to cheating.

Authentication alone in online examination cannot solve the basic pedagogical problems of validating knowledge and skills. On the contrary, an ethical consideration is that such a system could risk transferring the current testing regime in schools into distance education. To counter this, authentication should support validation of deeper understanding rather than testing if a student provided a "correct" answer according to a correction template. Validation of deeper knowledge is possible through dialogue, which is enabled in virtual learning environments through voice or video communication. In this paper a model for authentication in two-way real-time video based examination has been presented.

## 5. Conclusions

Currently, it can be safely assumed that cheating occurs at least to some extent in all forms of examination, traditional as well as in net-based distance education. If new and increased levels of control mechanisms are carelessly implemented, learners' intrinsic motivation will be at risk, and here online examination implementations are no different from traditional. Conclusions are that online examination becomes feasible when the associated cheat risks are not zero, but as low as in traditional examination and that students' integrity have to be considered in all learning modalities.

There are new digital techniques that could be combined to assure authentication in online exams without unnecessarily violating students' privacy or storing sensitive data. Authors' suggestion is a biometric belt and braces model with a combination of scanned facial coordinates and voice recognition, where only a minimum of biometric data has to be stored. Even if the model is based on biometrics with a medium to low grade of uniqueness and permanence, it would be reliable enough for authentication in online courses if two (or more) types of biometrics are combined with the presented dialogue based examination using an interaction/observation process via web cameras.

## 6. Future work

A question for further research is to investigate how authentication online could be used in dialectic and formative examination where dialogue rather than testing is central to validate a deeper understanding of what has been learned. This question builds on the results of this paper, as dialogue requires real-time two-way (or multi-way) communication.

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# Geocaching as a Means for Modernization of Educational Process

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**Abstract:** Geocaching is a real-world, outdoor treasure hunting game using GPS (Global Positioning System). Participants navigate to a specific set of GPS coordinates and then attempt to find the geocache (treasure) hidden at a certain location. A hint can be used as a tool for seeking. Simple rules, variability and the chance to experience the unknown make the game more attractive for the millions of players of various age categories all over the world. It is popular especially among younger generations, therefore we were inspired to implement Geocaching in the secondary education processes to make the learning modern and attractive. The implementation is based on the transfer of Geocaching principles to the learning conditions of nowadays schools, when the geocache creation and the game realization become parts of educational process. Teacher can adjust the form and the content of geocaches according to own demands, the curriculum and school conditions. Geocaching has been divided according to our needs into three basic elements - coordinates, hint and treasure. We have processed a set of concrete proposals how to use these elements in the educational process. For better understanding we have identified 10 structural components such as number, locality, text, video, etc. which teacher can use, freely combine and apply according to own needs. Teacher can also decide which teaching strategy is the most suitable for subject or topic. One of the options is Problem-based learning in which students learn about a subject through the experience of solving an open-ended problem. This strategy was implemented in practice. We have tested our proposals on students of grammar school in freshman year. Their task was to solve set of mathematical problems using preferred procedures utilizing knowledge of the GPS and mathematics. Using the principles of the game brings to the learning process a lot of benefits such as active learning, motivation, promotion of interdisciplinary relations and much more.

**Keywords**: GPS, Geocaching, project-based learning, secondary education, interdisciplinary relations

## 1. Introduction

Progress started by a revolution called "third wave changes" brought effectivity and modernization into the field of information communication technologies (ICT). Common users, private companies, governmental institution, non-governmental organizations as well as schools adjust to these changes. Demands are imposed especially on teachers to react flexibly and use available technologies within the modern education process (Amiree and Khabbazan, 2009; Luo and Bu, 2016).

ICT includes set of tools and resources used to communicate and for creation, search, disseminate, store, manage and interpret information in text, numeric, audio, or audio-visual form (Blurton, 1999).

We are witnessing a paradigm change in our schools from teacher-centered to learner-focused (Morel *et al*., 2003). The learning landscape requires new methods and perspectives to capture the new capabilities and learning processes (Knezek *et al*., 2013).

Simple applying ICT to the traditional practices in the formal educational system will not work. The traditional education system was principally based upon an objectivist approach, seeing knowledge as something that should be instructed, existing in a world independent from the experience of the learner (Paas and Creech, 2008).

Right usage of ICT can improve the quality of teaching, learning and management in schools and build knowledge across all domains of the curriculum and to help them build higher-order cognitive and life skills (Livingstone, 2012). It is important for all teachers to have the necessary knowledge and skills to integrate ICT in their daily teaching practice.

Due to the increasing popularity of mobile ICT devices (e.g. smartphones, tablets, GPS receivers) and the extensive and increasingly cost-effective availability of wireless Internet connections, mobile learning will become more important and useful in education, offering portability and choice as to when and where to use (Rensing, Tittel and Steinmetz, 2012).

### 1.1 GPS and Geocaching

It is an operational (navigation) system, providing users worldwide with non-stop precise position in three dimensions (latitude, longitude, elevation) and precise time traceable to global time standards based on earth-orbiting-satellite (Dana, 1997).

GPS applications have potential to be efficient tool for modernization of education process (Gargiulo and Metcalf, 2016; Shimon, 2011; Raessen, 2007; Bleck *et al*., 2012). Above mentioned authors use GPS via so called GPS Education Trail which includes location-based learning (LBL). This is an umbrella term for learning scenarios, services, and learning software which are especially related to the current residence of learning (Paeschke, Pardey and Seitz, 2013). Typical for the case of LBL is the connection with a game or gaming elements, because it creates a degree of emotional attachment for the learner (Zecha, 2014). An example which is closely related with LBL is Geocaching.

The simplest goal for Geocaching players is to hide and seek geocaches of various form hidden on various places. The basic geocache is a small watertight container that holds a pencil and a log book to record when the geocache was found. Small treasures (usually trinkets or inexpensive toys) are often placed inside the geocache so those who discover its location may obtain a reward for their find (Bragg, 2014).

Today location-based games with mobile devices including geocaching are popular among adolescents and young adults (Matyas *et al*., 2008). Evidence of the popularity of geocaching is also number of players from all around the world that exceeds the limit of 15 million (www.geocaching.com, 2016). This fact leads us to the idea to apply its principles in educational process. Huge popularity in the general public is a presumption that it can be successful among the students.

### 1.2 Geocaching in education

Implementation of Geocaching into the education process was described by a number of papers in the literature. Potential of Geocaching for teaching and learning in Science Education was evaluated by Hellgren, Stewart and Sullivan (2014) from the interview with students at primary school. Mathematical aspect emphasizes Bragg (2014) and Sparrow (2008): “Geocaching offers “real and relevant mathematics” through a need to develop spatial and location skills to engage successfully in treasure hunting”. Brown *et al*. (2015) examines the incorporation of Geocaching into the middle school classroom as a means to motivate gifted young adolescent learners. Zecha (2014) used principles of geacaches in proposals of GPS education trails. Matherson et al. (2008) realized social study on High School and they present GC as a teaching and learning activity. Jewett (2011) describes advantages for Geocaching use and its contribution for development of literacies. Creation of own geocaches and geocaching events for education purposes is shown in the work of Christie (2007). Szolosi (2012) in his article illustrates the use of instructional geocaching to carry out a multiphase project in which students were both the creator and consumer of a geocache event. Stombaugh, McLaren and Koostra (2005) present Geocaching as a one possible alternative for making a work with GPS device more attractive. The most complex overview on Geocaching is presented by Lo (2010), who characterizes Geocaching in detail, describes its principles, function, creation, realization, as well as possible application in education process.

There is a number of possibilities how to use Geocaching in education process. It all depends on the teachers’ competences, material base of the school and level of the students.

## 2. Methods

Our ambition is to create conception which can be used as a guide for teachers in creation of aim-oriented geocaches according to their own requirements, needs of the education discipline and possibilities of their school and its surrounding.

We come out from the presumption that the basic logic of the Geocaching consists of these 3 components: coordinates, which define location of a treasure, hint as a help how to find the right place of geocache and treasure itself. We have also specified 10 structural elements, which can be used for identification of the components:

- 1. Locality 6. Photo (or figure)
- 2. Distance 7. Video

- 3. Angle (or azimuth)
- 4. Number (or calculations)
- 5. Text (description)

8. Sound
9. Logical task
10. Practical task

Teacher can freely combine the components with structural elements to create education program for his students. He does not need anything except GPS receiver (or smartphone) and safe environment for realization. In the most cases, close surrounding of the school is sufficient. As a medium for mediation of individual structural elements a paper form, oral information from teacher (or another person), tablet or smartphone (e.g. use of QR code for running of multimedia file) can be used. Possibilities how to interconnect the components and structural elements are shown in the table 1 - 3. We tried also to summarize the concrete examples of use of coordinates, hint and treasure, which could be directly used in the secondary education in Slovakia.

**Table 1:** Examples of application of Geocaching components in education

**A - Coordinates**

| | | | | |
|---|---|---|---|---|
| Direct | N 40° 26′ 46.7″ W 79° 58′ 56.9″<br>N 40° 26.76′ W 79° 58.93′<br>N 40.4461° W 79.9832° | | | Number |
| Indirect | Computing | Mathematic | volume calculation, equations, math word problems | Number |
| Indirect | Computing | Natural Sciences | calculation Physics/Chemical formulas, counting errors in algorithms | Number |
| Indirect | Computing | Humanities | historically significant dates, number of states in EU, BMI calculation | Number |
| Indirect | Logical tasks | Intra- / Interdisciplinary | quizzes, puzzles, Sudoku | Number |
| Indirect | Practical tasks | Intra- / Interdisciplinary | calculating azimuths, geodrawing, tasks deriving from specific environment | Number |

B - Hint

| | | | |
|---|---|---|---|
| Direct | | hint without educational background (bench, tree, post-box) | Information |
| Direct | Natural Sciences | pyramid, spruce, Doppler effect, Fe, artesian well | Information |
| Direct | Humanities | Shakespeare's memorial plaque, Napoleons statue | Information |
| Direct | Practical tasks | oak, 2 m high, bird nest | Information |
| Indirect | Natural Sciences | under the only deciduous Conifer, place where you can watch the night sky despite of daylight, under device controlled by fingers | Information |
| Indirect | Humanities | birthplace of current president, under the table with info about fight in 1526, statue of 1st man in space | Information |
| Indirect | Logical tasks | riddles, puzzles, crosswords | Information |
| Indirect | Practical tasks | 2 m high | Information |

C - Treasure

| | | | | |
|---|---|---|---|---|
| Direct | | | treasure without educational background (gadgets, sweets, toys) | Localization |
| Direct | Place | Natural Sciences | arboretum, ZOO, Planetarium, Google headquarters, problematic place (illegal dump) | Localization |
| Direct | Place | Humanities | theatre, athletic stadium, European parliament, language school, | Localization |
| Indirect | Challenge (partial task) | | part of puzzle, coordinates, clue | Localization |
| Indirect | Task | Intradisciplinary | mathematical tasks, identify invasive tree species on site, book a hostel in foreign language | Localization |
| Indirect | Task | Interdisciplinary | prepare video-reportage about illegal dump (Informatics, Geography, Environmental Education, Ethics, etc.) | Localization |

Way of component expression
Two ways to obtain components
Specification of ways which leads to result
Field of component implementation
Examples

*Coordinates*

Coordinates means latitude and longitude. They are always in numeric form, usually in units of degrees. It means that result of every task must be a number. In relation with use of coordinate systems in education process, we can distinguish direct and indirect means of data obtaining. Direct methods mean that students get concrete coordinates in numeric form without any other activity. Indirect methods can be as computational, logical or practical task, which can be implemented in education of mathematics as well as Natural Sciences or Humanities (Table 1, part A).

*Hint*

Hint is information which helps students to find exact place with treasure. Teacher has opportunity of selection from two alternatives (Table 1, part B). It can directly inform student about the place (e.g. if the geocache is hidden in tree hole, hint can be English name of the tree, so teacher can test knowledge from Biology and English language). Alternative is indirect hint. It can be in the form of crossword with name of the tree as result. Teacher can prepare more demanding hint, e.g. if the result of the crossword is hint in English, or if whole crossword is in English. New possibilities for hints offer QR code. After scanning by smartphones or tablets various text, multimedia messages, links of video, sounds etc. created by teacher can open.

*Treasure*

Treasure location is based on coordinates and can have various forms. The simplest type of treasure is direct treasure in the form of specific place of interest (e.g. aim of excursion, object of education interest) or concrete thing which is related with the content of education of discipline. Indirect possibilities of treasure allow a wide range of options (Table 1, part C). Treasure can be a challenge (e.g. part of puzzle, mathematical exercise leading to further coordinates, or problem, which requires its solution right there on the place, QR code with multimedia message, etc.). Special case can be locality, which carries problem mark and it is not possible to solve it on the place. For instance if the "treasure" is an illegal dump. This can leave strong emotional experience in students, which can teacher use in the topic devoted to environmental problems.

In proposal of education process with use of Geocaching principles, teacher can freely combine components with structural elements, use individual components and choose various kinds of solution strategies (Figure 1).

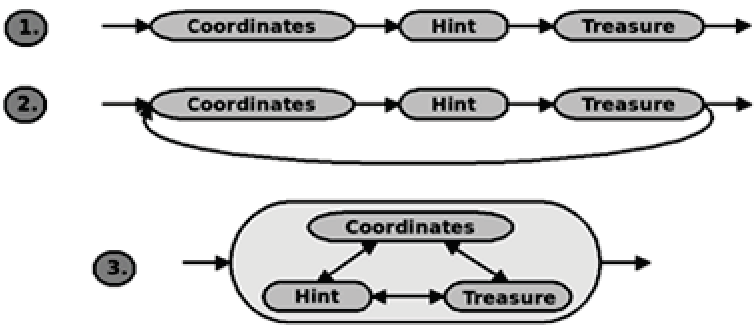


**Figure 1:** Strategy of task solving

- 1 - Components emphasized
- 2 - Process of realisation emphasized
- 3 - Result emphasized

Within creation of strategies for solution of tasks and problems teacher can emphasize individual components, process or result. If the components are emphasized, process of the game is defined in advance and level of component use can teacher set freely. He can focus on the parts, which he needs considering to aims, content and character of education, time and space conditions etc. This strategy is specific in ending of the game with the component treasure. Typical example for this strategy is an excursion or walking tour (e.g. teacher mediates coordinates and hint and students walk to the place which presents the aim of excursion).

Second strategy emphasizes process of program realization. Typical for this strategy is topic or story, which guides students during the program realization. Example of this strategy is GPS educational trail. According to

Zecha (2014) construction of a GPS education trail consists of entrance area, the main area (the course itself) and exit area. Solution is specific with changing of individual components during phases. In practice it means that students go from one treasure to another (from one place to another, from one task to another).

The third strategy emphasises the result. The components can be present in various volume and students determine the game process. Good example for task in this strategy can be a problem by the means of project education. Problem-based learning (PBL) can be defined best as the learning that result from the process of working toward the understanding or resolution of a problem (Barrows and Tamblyn, 1980).

## 3. Results: Example of teaching of mathematics with use of Geocaching principles

We have verified the use of Geocaching principles on the students of grammar school. Our proposal of education program used the strategy which emphasizes the result and (PBL) approach. The education program was focused on problem tasks from Mathematics. Geography was implemented within interdisciplinary relations, whereas students got new information of geography coordinate systems, they used latitude and longitude in location of points and orientation in terrain with compass.

The first step in our case was introduction of the problem to be solved. Problem situation transferred students to the world of surveyors. They often have to solve tasks requiring measurements and mathematical calculations in the terrain location of points.

Introduction was followed with instructions for work with GPS devices. Students learned practical setting of GPS device, location of point of interest by measurement and direct setting of coordinates, editing of points created, navigation towards points created with the possibility of distance following, work with compass and azimuth determination.

Then students divided into groups of four got assignment of problem to solve. Assignment contained task as well as coordinates and hint, which navigated to the points marked in terrain. The points presented entrances for the tasks. Figure 2 illustrates the problem situations.

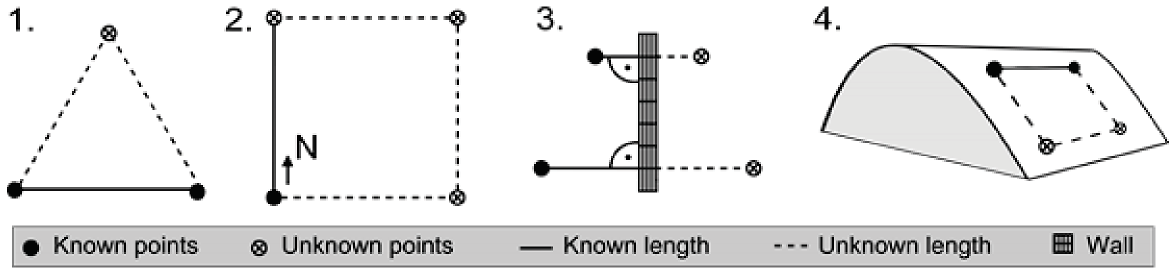


**Figure 2:** Visualisation of problem tasks

- *Task 1)* Given are the coordinates of two points. Find the coordinates of the third point in the space that is one of the vertices of equilateral triangle.
- *Task 2)* Given are the coordinates of a point that is a vertex of a square. Find coordinates of its unknown vertices, if you know that one of them is 25 metres to the north (south) of the given point.
- *Task 3)* Given are coordinates of the points on one side of a wall. Find the point coordinates that lie on the other side of the wall in the same distance like the given points.
- *Task 4)* Given are the coordinates of two points on the hillside. Find the coordinates of two points in the bottom part of the hillside that create a square with the given points (in the horizontal plane).

We asked the pupils to find different ways to solve tasks and based on their own experiences to choose the most precise method. In each of the presented tasks, pupils had at least two options how to solve them. The first one was to use GPS devices to find the unknown point. These devices enabled them not just to find the unknown point coordinates, but to determine the distance of the points, too. GPS devices worked with an inaccuracy (+/-3 metres) that affected the pupils' solutions. We pointed out that there is this inaccuracy for the pupils in order to lead them to mathematical solutions of their tasks. The use of mathematics is in this case the most accurate solving method. Pupils had all needed information. In the task assignment was mentioned how many metres in Nitra represent one degree of geographical latitude and longitude. It was important for them to notice the change of point coordinates when moving in space. It was also important to calculate how many degrees of longitude (E) and latitude (N) represent 1 meter in the space. They could calculate it like a quotient 1/N or 1/E.

Following part of article is devoted to analysis of mathematical knowledge that students could use to solve given tasks (problems).

*Task 1)*

Pupils had several options how to use mathematics. They could use goniometric functions and Pythagorean Theorem. They could split equilateral triangle into two right-angled triangles. So they could calculate the length of the height in the wanted equilateral triangle. With help of information about the longitude and latitude, pupils could more exactly find coordinates of the foot of the height to the base of the wanted triangle. Pupils could then use the found height to find coordinates of the unknown point.

In the same way they could use their knowledge about goniometric functions. They know that the angles in equilateral triangle are equal to 60°. Using sine or cosine they could calculate the height in the wanted equilateral triangle. Based on the information in the task assignment, it would be simple to calculate the coordinates of the unknown point. In the discussion we reminded pupils that they could find two different points. It depended on the choice of the half-plane where they moved.

*Task 2)*

Pupils could again come to more exact results with help of mathematics. They should correctly notice the change of point coordinates when they moved in the space to the cardinal points. It was necessary to express what part of longitude and latitude is represented by 25 meters in the space. They should add these numbers to the coordinates of the previous point or subtract them from coordinates of previous point.

It would be enough to use the first point to find coordinates of the unknown points. To find coordinates of the point that lies on square diagonal with the given point, they should calculate its length. The pupils used Pythagorean theorem to do it.

*Task 3)*

In this task pupils should apply their knowledge about axial symmetry. They failed in the question, what stays kept in the case of axial symmetry. They were not sure if the distances are the same.

When they wanted to solve this problem mathematically they had to find out two things. First was the change of point coordinates in the motion in the space and the other was the distance between the given point and the wall. It was necessary to add or subtract an adequate part of longitude and latitude degree from the coordinates of given points.

*Task 4)*

In this task, the pupils need goniometric functions and Pythagorean Theorem. Based on the given point coordinates they can find out the distance between known points, that is the length of the square sides. If the pupils know the angle of the slope, they can use cosine to find the distance of the given points and the unknown points in the bottom part of the hill. In case they know the altitude difference of the bottom and upper part of the hill, they can use the sine function to find this distance.

After solving the given problems, we took the pupils back to the class. We had a discussion about their strategies of work and about the obtained results. They all agreed that mathematical solution was the most exact. They could verify this statement using a computer. We gave them a simple table in that they could write their obtained point coordinates and verify their distance.

## 4. Discussion

Base of the popular, world known game Geocaching consists of three basic components (coordinates, hint and treasure) and uses GPS devices for point localisation and navigation of user. Application of the game principle in education together with sophisticated, aim-oriented and systemic approach of teacher brings certain benefits:

1. Offer of a wide spectrum of education possibilities

Combination of three basic components of Geocaching and 10 structural elements described above open for teacher a number of ideas usable in practice (examples are shown in tables 1, 2, 3). Teacher knows how to use these ideas for creation of education program. Education program, based on the Geocaching principle, characterises a direct support of interdisciplinary relations, therefore it gathers educational content of discipline selected with use of ICT, mathematical principles of localisation and geographic expression of position and spending time outdoors.

2. Development of a wide variety of knowledge and skills

Interdisciplinary character is present in a wide variety of knowledge and skills developed. Geocaching improves logic and problem-solving skills (Lo, 2010). Active use of ICT develops skills associated with ICT (Belisle and Rosado, 2007). Use of GPS mobile device for orientation in space increases place knowledge (e.g. referring to a teaching content) and spatial orientation skills (Feulner and Kremer, 2014). A lesson based on Geocaching can use a PBL approach for solving of concrete authentic problems. PBL develops reasoning, problem-solving and communication skills (Barrows and Tamblyn, 1980).

3. Increasing education attractiveness and motivation of students to learn

Our experiences with realisation of education with use of Geocaching game principle, as well as fact that outdoor education is more attractive for students and increases their motivation to learn. Students are frequently ready to benefit from instructional methods that involve play, collaborative learning, problem solving and other learning activities that promote higher-order thinking (Burns, 2010). But it all depends on personal approach of teacher, who would be not only a tutor but also facilitator of learning who encourages students to take the lead. Under influence of teacher „A lesson based on Geocaching can be something as simple as a class hour spent hunting for geocaches on the school grounds. Alternatively, the lesson can be an elaborate interdisciplinary experience that feature mathematics, cartography, geology, ecology, language arts, industrial arts, computer programming, physical education, field trips and a unit-culminating project Lo (2010)."

4. Use of information-communication systems

The geocaching game uses GPS. GPS applications require use of GPS device. But nowadays this function can substitute common smartphones or tablets, which students mostly own. So it is not necessary to buy expensive GPS devices. In general students love to use the technique and they learn very fast how to use devices and their applications for their own profit.

5. GPS applications allow positioning of their user (and also arbitrary object or phenomenon) with certain accuracy. So GPS can be used in PBL according to criteria of Thomas (2000), problem-based learning or inquiry-based learning. With use of GPS students can map chosen objects and phenomenon, record their movement, suggest location of certain objects, measure distances, solve mathematical tasks, draw pictures by their movement etc. Students are also able to propose a simple education program which uses principles of Geocaching for their classmates. So it is possible that students became authors of e.g. GPS education trail.

## 5. Conclusion

Inspired by the game Geocaching, we have created the conception intended especially to the teachers of secondary education. The conception is based on components and elements described above and it comes from our own observations from the work with students and brings several benefits for the both sides of education process. From the teachers´ point of view, we see main advantages in increasing interest of students in the discipline and education content; modernisation of education with use of ICT; variability in selection of aids, approach and methods; possibility to bridge over the content of education with practical life tasks, direct support of interdisciplinary relations and possibilities of self-realisation.

Our conception brings for students a number of advantages, as well. We could mention the most important. Solution of practical problems requires interdisciplinary approach. Students obtain a wide scale of knowledge arising from curriculum and develop several practical skills (e.g. problem-solving skills, skills associated with ICT, spatial orientation skills).

Use of ICT in education, realisation as a game, solution of problem tasks, outdoor education, use of group work and competition with rewards make education more attractive for students and motivate them for learning.

Based on our own experiences we see application of Geocaching not only in secondary education, but also in life-long learning of pedagogues. We can conclude that elements of Cheocaching could be an important part of education process and help to its modernisation.

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# Effectiveness and Efficiency of Blended Learning Model for Developing Leadership Skills

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**Abstract:** Institutions of higher education are increasingly adopting blended learning, because it has been widely demonstrated that blended learning could be a better learning model than pure face-to-face classroom teaching or online learning. However, literature reviews show that many institutions mostly implement blended learning rather than evaluate the potential benefits. As blended learning continues to grow in popularity, so researchers must explore the potential and limitations of this field in depth. The aim of this paper is to present research results of effectiveness and efficiency of a hybrid learning and teaching model for developing leadership skills among graduate students. The authors focused on two important things. First, the authors investigated how to enhance benefits of blended learning for leadership training for working students and, second, the authors explored the drivers of blended learning for working students in order to achieve high quality teaching and learning experiences. Blended learning has been shown useful and beneficial when used to attract experienced teachers from abroad to university courses when they cannot come for the whole semester. Therefore, the paper analyzes theoretical aspects of employing a blended model to teach degree level as well as executive level studies in a university context, and the applicability of this model in the context of leadership courses. In order to empirically test how efficient and effective the hybrid model is for teaching and learning leadership, a qualitative case study research strategy was chosen. This strategy allowed interpretive, contextual, and authentic evaluations instead of objective, non-contextual, and inauthentic evaluations. The research results are based on the case study of recently developed leadership studies course at one Lithuanian university. During the research, it was found that blended learning provides powerful and efficient methods for course participants, however, several things need refinement. In particular, some aspects of learning design, learning material and modifications at organizational level.

**Keywords:** blended learning, e-learning, efficiency, effectiveness, leadership studies, collaboration

## 1. Introduction

The range of activities involved in e-learning can encompass the basic implementation of a learning management system (LMS), to individual activities that utilize a specific technology, to flexible course delivery with whole online course offerings through distance education and massive open online courses (MOOC) and everything in between. This confusion in terms and explosion in use of technology in higher education suggests that blended and online delivery of higher education programs is growing at a greater pace than the current understanding of the implications of this trend (Gregory & Lodge, 2015).

The term "hybrid course" is used by scientists and practitioners interchangeably with the term "blended learning" (BL) and invokes a model of course design that combines traditional, face-to-face class time with online and out-of-class course work (Dictionary). Institutions of higher education are increasingly adopting BL (Porter, Graham, Spring, & Welch, 2014), because e-learning has been presented by many as a means of equalizing access to quality education, and there are an abundance of academics who extol the benefits of web-enabled learning (McClintock, 1999).

It has been widely demonstrated that BL is a better learning model than pure face-to-face classroom teaching or online learning (Garrison & Kanuka, 2004). Therefore, for many institutions, “the pressure is to maintain and deliver services rather than to judge their effectiveness, i.e. to implement rather than evaluate” and evaluations will move from being “objective, non-contextual, and inauthentic” to “interpretive, contextual, and authentic.” (Porter, et al., 2014). BL creates learning environments in which all parts of it must be considered, i.e. learning design, learning process, learning material, learning evaluation and BL organization. Learning efficiency and learning effectiveness are two important factors for the characterization and the related success or failure of learning environments. The extent of learning efficiency and learning effectiveness depends on different drivers. As a result, it is important to determine the influence and effects of the drivers on learning efficiency and learning effectiveness (Reiss & Steffens, 2010; Renner, Laumer, & Weitzel, 2014). According to (Reiss & Steffens, 2010) study, BL is currently predominantly used in single courses, but not as a program of study and thus falls short of the expectations with respect to performance enhancements in higher education.

The aim of this paper is to present research results on effectiveness and efficiency of a BL and teaching model for developing leadership skills among working students in particular. The authors focused on two important things. It was analyzed how to enhance: a) the learning benefits, i.e. effectiveness and efficiency of BL for leadership training for working students and, b) drivers of BL for leadership training for working students in order to achieve high quality teaching and learning experiences.

Section 2 describes the theoretical background of BL focusing on: a) Theory and practice of the BL in higher education institutions, b) Measuring the efficiency and effectiveness of BL courses, and c) Using a BL approach in developing leadership skills. The research questions, overview of a case study as a research strategy, the data of the case study and research methods used and limitations of the methodology are presented in Section 3. Description of the course structure, learning material and learning activities and the results of a case-study are presented in Section 4, while Section 5 provides discussions and the main conclusions.

## 2. Theoretical background

Despite current popularity of the term BL (BL, computer-aided instruction, computer-aided learning, integrated learning, hybrid learning, multi-method learning (Rowe, Frantz, & Bozalek, 2012), e-learning, v-learning (Archee, 2015)), considerable variation in definition exists across institutional contexts, and the landscape of BL continues to evolve rapidly (C.R. Graham, 2013), and new technologies are adding even more complexity to identifying the exact ingredients of this hybrid recipe (Archee, 2015).

### 2.1 Theory and practice of the blended learning in higher education institution

Graham (2005) stated that blending can occur at different levels: activity level, course level, program level, institutional level. The presented model is blended at both course and institutional levels, because BL is useful and beneficial when programs seek to attract experienced teachers from abroad to the university courses who cannot come for the whole semester. Based on the learning experience taxonomy adopted by (Margulieux, 2014) (Park, Yu, & Jo, 2016) identified four major types of learning using two dimensions of pedagogy and delivery: (1) mostly face-to-face class with substantial online activities, 2) mostly online class with student offline group meeting, 3) mostly face-to-face lecture with online resources, and 4) mostly online lecture with optional face-to-face meeting. This approach could be used to categorize research conducted on BL and helps to position the current research. The authors in the paper present BL model of type 4$^{th}$, i.e. mostly all lectures were online with several mandatory face-to-face meetings.

As (Halverson, Graham, Spring, Drysdale, & Henrie, 2014; Park, et al., 2016) noted, BL has been classified in diverse frameworks and approaches. However, currently, no single approach exists for BL; rather various institutions require a unique blend of face to face and online interaction to address learners' specific needs and customization of the teaching learning environment (Kumar, 2016). (Halverson, et al., 2014) stated that the focus of previous research has been on definitions, models, and the potential of BL. There has been limited empirical research on BL. This research aims to fill the gap and to report on an empirical study of academics' and students' views about effectiveness and efficiency of a BL model for developing leadership skills within a single Lithuanian institution. (Charles R. Graham, Woodfield, & Harrison, 2013) provided a BL adoption framework that include three broad categories: strategy, structure, and support and their subcategories. Respectively, each subcategory has its stage: stage 1 (Awareness/Exploration), stage 2 (Adoption/Early implementation) and stage 3 (Mature implementation/growth). As authors presented the first experience within implementation of BL, therefore according to (Charles R. Graham, et al., 2013) the model presented a first stage and refinement and improvement should be considered.

As BL continues to grow in popularity, so researchers explored the potential and limitations, benefits and challenges of this field (Drysdale, Graham, Spring, & Halverson, 2013; A. Graham, 2005; Poon, 2013). (Kumar, 2016; Poon, 2013) noticed success/major issues for BL which are grouped in three groups: 1) Faculty Related (Faculty development, finding time to research, etc.). 2) Student Related (Student learning and management, Student satisfaction, etc.) 3) Institutional (Technological Infrastructure, Quality assurance, Cost and benefits). (Draffan & Rainger, 2006) identified challenges from student and teacher perspectives and argued that therefore, in order to facilitate inclusive learning, BL models should ensure students can interact successfully with the technologies, themselves (through reflection), peers, teachers, support workers and learning materials (Harris, Connolly, & Feeney, 2009; McCutcheon, Lohan, Traynor, & Martin, 2015).

Considering BL research from a research methodologies point of view, much has been contributed by (Bliuc, Goodyear, & Ellis, 2007). The researchers categorised research methodologies used to investigate BL in four groups: 1 ) case-studies; 2) survey-type studies; 3) comparative studies; 4) comparatively more holistic studies which examined how the different components of BL related to student learning.

(Spanjers et al., 2015) summarized 5 previously completed meta-analyses which examined the effect of BL or blended and computer technology-enhanced learning, but the more recent 2014 meta-analysis (Bernard, Borokhovski, Schmid, Tamim, & Abrami, 2014) focused solely on higher education, and included studies from 1990 in their review. This meta-study found that BL benefits students on average one third of a standard deviation, with more specific gains enabled by the genre of computer support, and the kind of interaction that is encouraged (Archee, 2015).

BL is being pursued in higher education as a means to support students and a need exists to assess its effectiveness (McCutcheon, et al., 2015). Learning effectiveness has been broadly studied; authors used different indicators or combinations of indicators as well as models, but literature reviews offered only a few results for learning efficiency (Renner, et al., 2014). Learning efficiency and learning effectiveness constituted two important factors for the characterization and the related success or failure of learning environments (Renner, et al., 2014). Factors of learning effectiveness have been examined in e-learning or traditional learning settings, or included in a comparison of them (Renner, et al., 2014). Some authors categorized factors that influence learning (Noesgaard, 2015; Renner, et al., 2014). Research identified which of factors appeared most important, but indicated that importance depended on learning context. In summary, clear factors for measuring learning effectiveness and learning efficiency of BL environments have not been identified (Renner, et al., 2014).

## 2.2 Using blended learning approach in developing leadership skills

Training leadership can be challenging, even deceptive, as it is such an ambiguous concept (Brittain, 2014) therefore, BL also has been used effectively in leadership development (French, 2014). (Silbergh & Lennon, 2006) stated, that the way in which leadership skills can be meaningfully developed in the empirical world is of course once again a highly contentious issue, particularly, whether or not such skills can only/can best be developed through face-to-face encounters, contrasted with a mediated online learning environments. Therefore, only several published papers have been found that addressed the issue of developing leadership skills through a mediated online learning environment, mainly BL. Although research studies on the application of BL in higher education continue to increase, little is known about empirically tested effectiveness and efficiency of such courses, particularly on leadership learning.

**Table 1:** Blended models for leadership training and developing skills

| Authors | The organization of leadership training | Research methodology | Research findings |
|---|---|---|---|
| (Voci & Young, 2001) | The six-month leadership development program. The method employed to undertake the pre- and post-course assessment of skills, the degree of improvement in skills achieved/who achieved them etc. Assistance of a supervisor. | An annual analysis of the overall program results. | Positive outcomes are reported: the effect of these combined online learning experiences with stand up instruction is potent; participants praise the curriculum in final program evaluations, citing the sense of heightened teamwork and camaraderie. |
| (Lewis, 2006) | A three-phase blended learning program for leadership and management that combines online leadership skills training with face-to-face human interaction. | Quantitative and qualitative data analysis. | Analyses led to conclusion that students perceive real and lasting leadership improvements directly linked to the training. BL intervention achieved positive effects at each Kirkpatrick level. |

| Authors | The organization of leadership training | Research methodology | Research findings |
|---|---|---|---|
| (Lee, 2010) | Describes a 6-week management leadership development program offered by a corporate university in Korea that transformed from a face-to-face delivery to a blended format. | Integration of the descriptive and predictive statistical analysis with qualitative data analysis. | Based on the integrated results, the instructional design guidelines for specific instructional components related to blended training are presented. |
| (French, 2014) | The program had two major streams: development of leadership competencies in a personal learning plan and implementation of a change initiative to support an agency systems change. | A case study based on pre- and post-assessments. | Across all modules, supervisors reported statistically significant competency gains from pre- to post-training that remained significant at six months post-training. |

(Lewis, 2006) used a three-phase BL program for leadership and management that combined online leadership skills training with face-to-face human interaction; (Voci & Young, 2001) transformed e-learning into instructor-led six-month leadership development training program in order to benefit from instructor-led training and e-learning at the same time; (Lee, 2010) described a management leadership development program offered by a corporate university in Korea that transformed from a face-to-face delivery to a blended format; (French, 2014) presented the program that had two major streams: development of leadership competencies in a personal learning plan and implementation of a change initiative to support an agency systems change and showed that it offered an effective learning model during which leadership skills improved.

## 3. Research methodology

The qualitative case study research strategy was chosen for the research. It consisted of the following data gathering methods: (1) the analysis of the course content, teaching methods and technological implementation, (2) the evaluation of the efficiency and effectiveness of the course based on the survey of the students who have successfully completed the course. The structure of the survey consisted of three parts and was based on other researchers' work ((CDL), 2016; Owston, York, & Murtha, 2013).

The first part was devoted to students' experience in an enrolled BL course and comprised eight questions concerning the relevance of topics, usefulness of the teaching methods applied, time spent on course and satisfaction. Two of eight questions were open-ended. In the second part using seven questions students' attitudes and personal traits concerning their experience in other BL were gathered. The last part had five demographic questions of students, e.g. age, education, level of employment, etc. The students' survey information was analyzed using the method of thematic analysis. During the analysis authors were exploring for successful factors of effectiveness and efficiency of BL for leadership that were previously identified in the literature review.

To fulfil the stated purpose of the research, the following research questions were addressed:

RQ 1. *What are main drivers of the effectiveness and efficiency of blended learning for working-students?*
RQ 2. *What are main drivers of blended learning for working-students in leadership studies?*

In order to draw the picture of quality of presented BL course, SWOT analysis was done on the basis of open-ended questions. The authors investigated drivers of the effectiveness, efficiency, both the convenience and flexibility of blended learning for working-students (Table 2). The research methodology has some limitations. The first is that the results obtained cannot be generalized because of small population. There were only nine surveys distributed and all of them completed. Obtained data were combined and analyzed.

**Table 2:** Factors and drivers

| Factors | Drivers |
|---|---|
| Effectiveness | Satisfaction, Students overall, subjective appraisal of BL, Motivation. |
| Efficiency | Content, Methods, Convenience and flexibility, Communication amount and quality. |

## 4. Study results

### 4.1 Description of the course structure, learning material and learning activities

The blended course on leadership studies for personal and professional development was created and implemented at one public mid-sized Lithuanian university. The course was presented together with a professor from the USA who was already known and very well accepted by university's Master studies students. The purpose of the course was to develop leadership talent within four areas of competency: leadership; interpersonal skills; organizational skills; personal traits. To attain those competences, one topic for each of twelve weeks was composed. Topics pertinent to generally accepted principles of leadership were selected such as: communication, motivation followership, diversity, moral courage, empowerment, creating vision and change management.

Using (Daft, 2014) model, the course was divided into three distinct categories of the leader as an individual, the leaders as a relationship builder, and the leader as a social architect. Fourteen self-assessments were incorporated into the weekly topics, and participants were instructed to complete, score and reflect on the assessment outcomes. The course was implemented using the existing virtual learning environment, Moodle. The structure of the course is represented in figure 1 and was divided into three parts. The first week of the course was devoted for introduction, during which the participants were introduced to the leadership concept and three perspectives to characterize leadership: leader as individual, leader as relationship builder, and leader as a social architect. During the introduction session students had also to perform the following activities: to create (for non-university participants) or update (for the participants from the university) their Moodle profile by adding a short personal introduction; to write a short pre-reflection about how they perceive themselves as a leader and what are their expectations from the course; and to read the pre-course material.

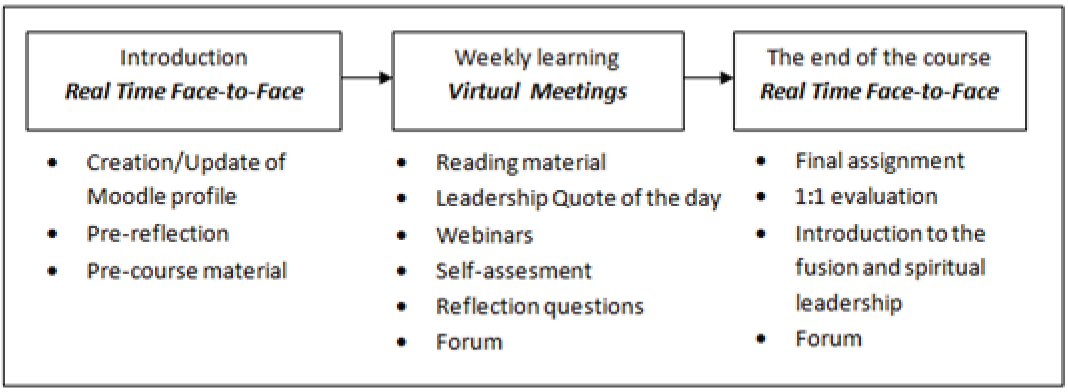


**Figure 1:** The structure of the course

During the weekly learning on VLE Moodle, students read learning materials, and reviewed power point slides. Two kinds of learning materials were employed: mandatory and optional. For more effective communication and collaboration webinars were added which allowed a platform for disseminating information, addressing student questions and discussing information in real-time. For self-control two kinds of tasks were designed: self-assessment and reflection questions. The learning material was also supplemented by the weekly news forum where various articles about current trends in leadership were posted as well as leadership quote of the day to encourage students' to visit virtual learning environment each day. The course was designed to be completed in 12-15 weeks, but due to the university holidays it lasted longer starting from November, 2015 and finishing in May, 2016.

After the final week of the course, week 12, the final assignment for students was introduced. Specific instructions for that task were given using forum and webinar, and extra one-to-one meetings (student-teachers) was organized to receive primary feedback about learning both from students and teachers. The final assignment was the creation of the individual leadership profile where students were required to describe the main self-assessment tools they have taken, to interpret their scores and suggest the interventions they would use to improve these scores. The participants had also to come up with the picture that would illustrate their leadership style best and then to write a 3-5 page summary about themselves as leaders which they could use for their personal and professional growth in the future.

### 4.2 Results of a case study

The research results are based on the case study of the above described course at one Lithuanian university. Nine completed surveys were received. The age of respondents varied in the interval from 24 to 39. All students were female and full-time employed, except one was unemployed. Six of them were enrolled to the university degree studies (2 bachelors, 5 masters, 1 PhD and 1 bachelor in progress) during the participation in the leadership course. The study reveals that all students enrolled in the course had high-level motivation: 77.8% of them were very motivated and 22.2% motivated to succeed.

Considering research questions next results about each of driver (Table 2) is described. The most relevant topics of the course were: Leadership Communication (100%), Motivation and Empowerment and Leader as individual (88.9%). There were not any irrelevant or totally irrelevant topics (figure 2).

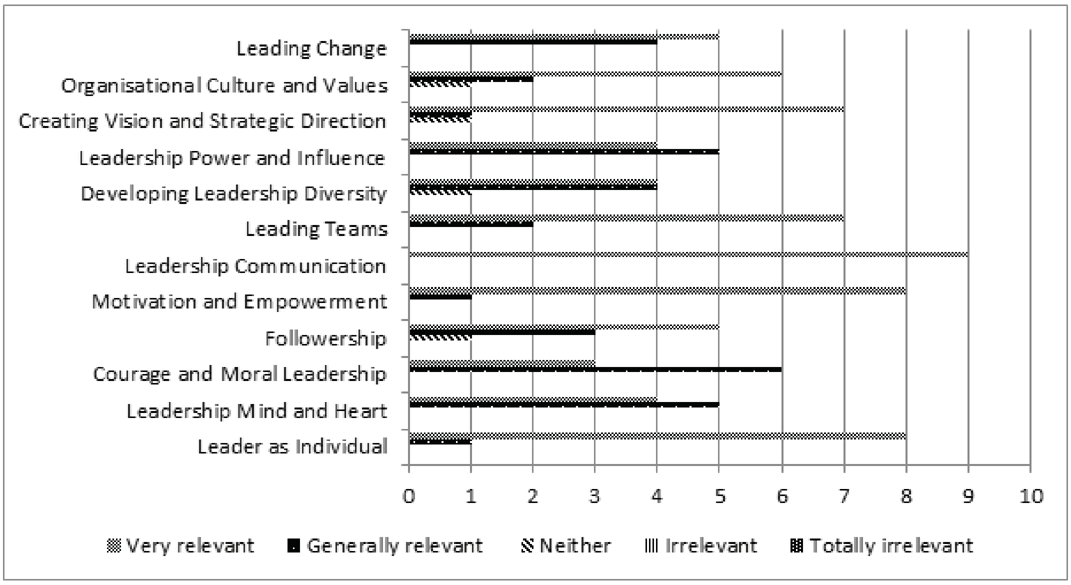


**Figure 2:** Driver content – the relevance of topics

Individual consultations on personal leadership profile and Creation of personal leadership profile seems to be useful methods for students (88.9 %). Among methods used for some students there were some generally un-useful methods, such as News forum (22.2%), Leadership Quote of the day and Online webinars (11.1%) (figure 3).

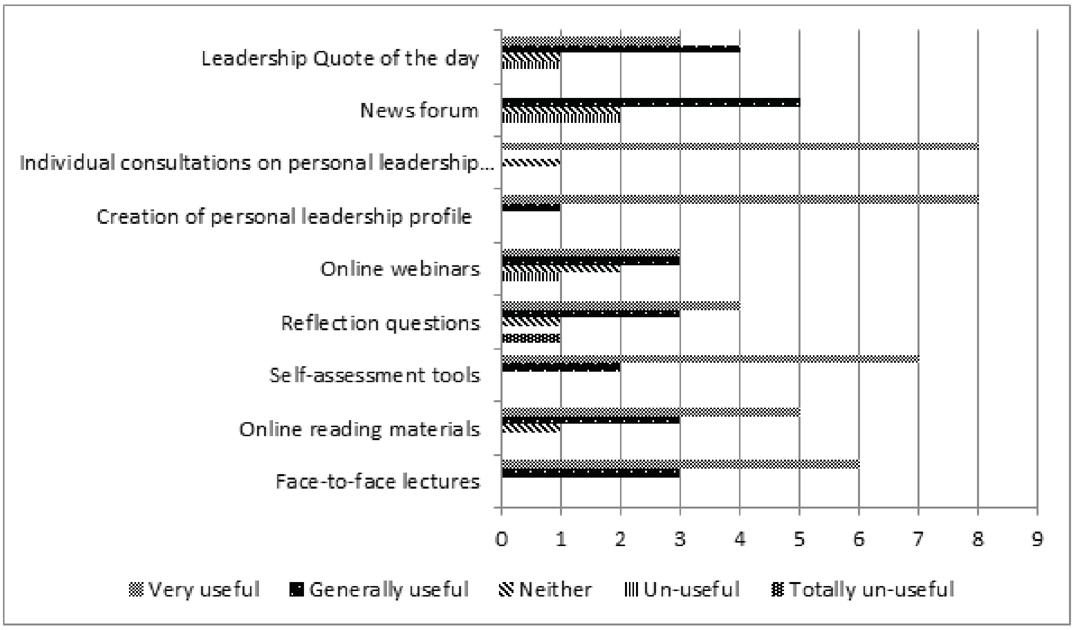


**Figure 3:** Driver methods – the usefulness of methods

Results show that 77.8% of students were generally satisfied with the course, but one student was very dissatisfied, and one very satisfied. In order to find out students overall, subjective appraisal of BL it was asked if they recommend that course for friends/relatives. Results show that 66.7% will possibly recommend and 33.3% definitely recommend it for others.

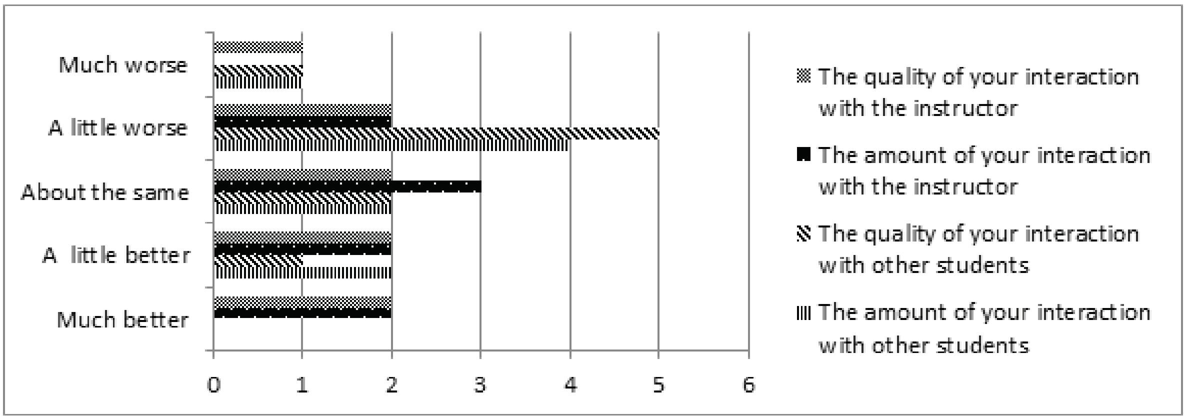


**Figure 4:** Driver communication amount and quality

Fig. 5 shows students' attitudes to BL: flexibility and convenience were most important factors.

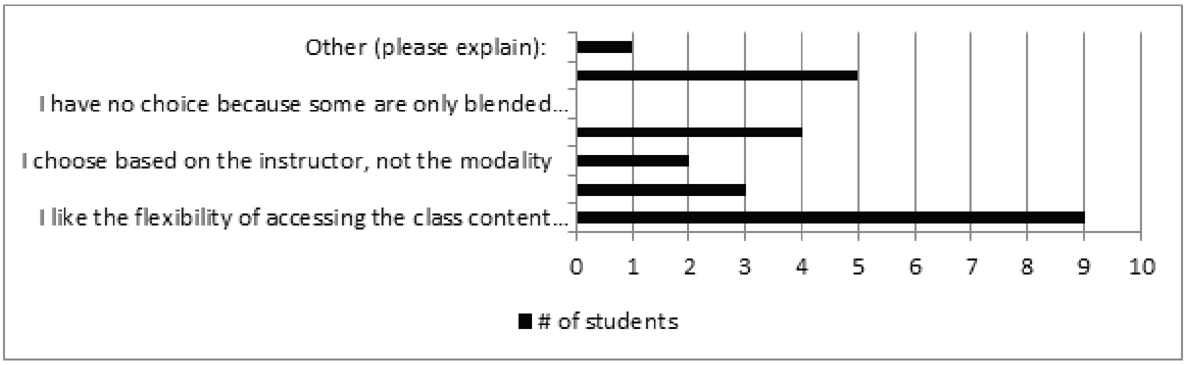


**Figure 5:** Driver flexibility and convenience

In order to draw the picture of quality of presented BL course SWOT analysis was done on the basis of open-ended questions (Table 3). It was observed that main weaknesses are related to technology issues, which must be managed before the course. Opportunities for improvement of the course also have been identified and will be considered while redesigning the course.

**Table 3:** Results of SWOT analysis

| | |
|---|---|
| *Strengths*<br>Most important topics are covered<br>Reflections and self-assessment tools<br>Flexibility and convenience of the course schedule<br>Opportunity for participants to gain insights into personal leadership attributes | *Weaknesses*<br>Lack of user-friendliness format of content<br>Intermittent technology issues with Moodle<br>Webinar structure needs refinement<br>Audio-visual issues with webinars |
| *Opportunities*<br>Creation of opportunities for practical application of theory<br>Template guidance for reflections (e.g. use of journals)<br>Additional face-to-face lectures (e.g. in the middle of the course)<br>Enhanced visual material | *Threats*<br>Retention of enrolled students<br>Inconsistency in participation<br>Gap between course objectives and participants' expectations<br>Technology accessibility |

## 5. Conclusions

This paper analyzed both theoretical and practical aspects of using a blended model to conduct the degree as well as the executive studies program at the university level, and the applicability of this model in the context of leadership courses. Researchers found that blended learning provides powerful and efficient methods for course participants: almost 80% of participants indicated they were generally satisfied with the course and would recommend it to others. The strongest points of the designed blended learning were related to learning topics, schedule and well designed and implemented reflections and self-assessment tools. Additionally, students expressed approval for the teaching team, but described a deficit to the production team. In particular, format of learning material presentation and communication tools among students need to be revised and refined. Also technical issues, such as audio, video quality needs improvement. Research results revealed that usage of international academic collaboration needs more exploration in order to achieve high quality teaching and learning experiences. Based on the current findings, additional research on blended learning would be useful, particularly from student, faculty, technology support and administration perspectives with the aim to investigate cost effectiveness of blended learning in education.

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# PhD Research Papers

# How Czech Universities Cover Web Development Teaching in Their Curricula

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**Abstract:** Nowadays, nearly everyone is using the Web. However, the developing of proper and well-designed web pages is something between art and skill in relevant technology exploitation. Adequate skills are not likely to be gained individually, but it is reasonable to have them covered in university curricula at some level. This paper is devoted to the current situation in Czech universities with a focus on those curricula, where coverage of subjects oriented towards web technologies can be expected. An analysis of a number of syllabi of subjects focused on web technologies in the study programmes of nearly all Czech universities was provided and its results are presented. The results of our analysis are as follows: (1) the subjects focused on web development are being taught at the majority of Czech universities, apart from those that are artistically oriented; (2) the level of content of the respective syllabi varies significantly, and it is not much tailored to practical convenience. In conclusion, we are convinced that the implementation of the basic principles of the systems theory could contribute greatly to an improvement in the interestingness of web development-oriented subjects for academicians as well as their usability for students. It has already been proven that web presentation is a system, so we believe that it is obvious that this fact should also be reflected in web development teaching at universities in the Czech Republic, and certainly also elsewhere.

**Keywords:** web development, teaching, curricula, Czech universities, system theory, analysis

## 1. Introduction

Nowadays, an enormous number of people around the world are using the Web. However, the developing of proper and well-designed web pages is something between art and skill in relevant technology exploitation. The necessary and adequate skills are unlikely to be gained in an individual study process, but it is reasonable to have them covered in university curricula at some level. This paper is focused on the current situation with web pages development teaching at Czech universities. We have analysed those curricula, where we expected some coverage of subjects oriented towards web technologies and web pages development. An analysis of a number of syllabi of subjects oriented towards web technologies in the study programmes of nearly all Czech universities was provided and its results presented. To be more precise, there are 26 public higher education institutions in the Czech Republic; however, four of them are oriented purely towards the arts, and another one narrowly specializes in veterinary medicine and pharmacy. Therefore, since the analysis does not cover all the public universities in the Czech Republic, we decided to take into account just 16 of them, all with regularly taught web-oriented subjects. We omitted all the private higher education institutions intentionally, as they educate just 11% of all the Czech higher education students, and their level of education varies significantly. We analysed only public sources, that is, publicly accessible web pages of the respective universities, where the syllabi of web-oriented subjects could be found. The resulting sample consisted of 21 subjects taught at 16 public higher education institutions. The results of our analysis are as follows:

- the subjects focused on web development are being taught at the majority of Czech universities, apart from those that are artistically oriented;
- the level of content of the respective syllabi varies significantly, and it is not much tailored to practical convenience.

There is a number of various possibilities for improving the level of web development-oriented subjects. Based on our experience, we are convinced that the implementation of the basic principles of the systems theory in these subjects could contribute significantly to an improvement in their interestingness for academicians as well as their usability for students. It has already been proven that web presentation is a system, so we believe that it is obvious that this fact should also be reflected in web development teaching at Czech universities and elsewhere.

## 2. General system theory basics

General system theory (GST) is a concept defined by Ludwig von Bertalanffy in the middle of the twentieth century as criticism or reaction to usual academic approach at that time, which was unable, in some cases, to describe the reality of the surrounding world in an appropriate way. According to (Bertalanffy, 1969), GST should even become a meta-science covering all other sciences. The basic principles of GST mentioned in this paper are briefly described. More information can be found in the references (Bertalanffy, 1969; Bureš, 2007; Bureš and Čech, 2008; Horfkirchner, 2010; Rapoport, 1968).

A *system* can be defined in many ways; however, a system surely consists of a number of parts that are connected and cooperate. A system cannot be a plain collection of items. An *open system* is a system interacting with environment, often involving organisms (people). A *synthetic approach* sees a system as a unit related to and communicating with its surroundings. The synthetic approach was introduced as a criticism of the mechanistic and reductionist approach, which focused too much on analysis and inner details of systems. *Synergy* is the effect where the output is bigger than the sum of inputs. *Feedback* is a mechanism enabling a self-regulation of a system and maintaining its dynamic equilibrium. During feedback, the output from a system becomes its input. *System archetype* is behaviour or phenomena that occurs in a very similar way in many different situations. Therefore, discovery of such behaviour might be done repeatedly in different fields. *Multidisciplinarity* is the cooperation of many academic fields, which is in contrast to highly specialized fields.

## 3. Web development

Web development is the activity of creating HTML and CSS codes to build closely interconnected web pages – a website. The activity can include many other technologies and knowledge. However, involvement of HTML and CSS is essential. Partial usage of HTML in more complex applications, such as enterprise information systems, is not considered in this paper. In the beginning, web development involved only simple formatting of interconnected pages. Later, other components and technologies were utilized: more complex formatting, client-side interactions, server-side scripting, design, marketing, psychology, statistics etc. Miller (2011) says: *'Web designers have gone from being technicians and hobbyists to critical members of the business environment'*. The phases of web development are described differently in various sources but common items can be found:

- Planning, visual design, development, content, testing, launching (Emond and Steins, 2012).
- Preproduction, production, maintenance, evaluation (Friedlein, 2001).
- Planning and usability, design and typography, and analysis and business value (Miller, 2011).

Řezáč (2014) says that a business website should fulfil one of three basic goals: make a conversion action, provide information, or support a brand. Methods, procedures and best practices to develop a successful website are widely available in the literature and on the Internet:

- 'Successful project management is about ensuring the right blend of diverse skill sets and cultures needed to produce a truly great Web site.' (Friedlein, 2001)
- 'Balance between design, usability and ROI that makes a Web site truly great.' (Miller, 2011)
- 'It is a combination of technology, UX design, content creation, psychology, sociology, marketing and branding.' (Řezáč, 2014)

Including other authors' opinions (Berthon et al, 2012; Dogan et al, 2014; Chaffey et al, 2009; Emond and Steins, 2012; Krug, 2006; Levy, 2015; Li, 2014; Thompson and Pian, 2004), the following topics can be highlighted as vital for a successful website:

- strategy, project management,
- return of investment (ROI), key performance indicators (KPI),
- conversion rate, call to action,
- marketing, unique selling point (USP),
- A/B testing, user testing, user experience (UX).

However, many of websites are not created properly and they ignore these points. As a result, they don't fulfil their goal (Fogli and Guida, 2015; Hieronimus and Kullmann, 2013; Mehrtens et al, 2001; Řezáč, 2014). We assume that one of the reasons for this is that web development is not taught in an appropriate way.

## 4. Analysis of web development teaching

To prove the assumption, Czech university curricula of subjects related to web page development were analysed. The universities were selected as the resource for this research because they are supposed to be the highest level of education, they are under the control of the accreditation commission and their curricula are usually public. There are 26 public higher education institutions in the Czech Republic; however, four of these are oriented purely towards the arts, and another one narrowly specializes in veterinary medicine and pharmacy. Therefore, the analysis cannot cover all the public universities in the Czech Republic. We decided to take into account 16 universities, where web-oriented subjects are taught regularly. Therefore, the curricula of 21 subjects were included. In most cases, one subject per university was selected. If more faculties teach web page development, more subjects from one university could be included. Authors decided not to analyse all subjects as there is no unerring way to get a complete list of subjects taught in the Czech Republic. Moreover, as only one subject per organization was selected, it was usually purely focused on web development. Otherwise, other subjects varying from programming to marketing would have to be included as they sometimes include web development techniques.

All curricula have been found in the public parts of university websites. Curricula of subjects containing words “www”, “web” and “internet” were sought. If possible and applicable, the chosen subject was

- compulsory,
- first in a row of related subjects,
- studied by most students comparing to the other related subjects,
- mostly focused on web development.

In the first step, subject goals, annotation, and content were analysed. Also, if available, related subjects, number of students, number of teachers, related study programmes, requirements for credit and number of hours per week were considered. Authors mostly focused on subject content, the most important part of the curriculum, describing content of every session, usually in the form of an ordered list. This part was quantified as described below. The other information from a curriculum was taken into account when selecting the most appropriate subject for this research, as mentioned in the list above. Also, the unusual parts of curricula are mentioned separately later.

Although names and goals of the subjects vary, according to our research most of the subjects follow the same structure: HTML – CSS – programming – others. The “others” section might include items like optimization, marketing, testing etc. Programming might include client-side scripting (JavaScript), as well as server-side scripting (PHP, .NET, Java). In some cases, principles of computer networks (DNS, HTTP) are taught first. In some cases, this curriculum is divided into more related courses. Table 1 shows absolute and relative frequencies of different topics included in the analysed curricula and the number of subjects following the most usual structure. Items are ordered by the frequency of appearance.

**Table 1:** Frequency of topics included in curricula

| **Subject includes** | **Number of occurrences** | |
|---|---|---|
| | **Absolute** | **Relative** |
| Usual structure of curriculum | 17 | 81% |
| Accessibility | 8 | 38% |
| SEO, PPC | 5 | 24% |
| Responsive design, mobile devices | 4 | 19% |
| Content management systems (CMS) | 4 | 19% |
| Usability, user testing | 3 | 14% |
| Statistics | 2 | 10% |
| Copywriting | 1 | 5% |
| **Total** | **21** | **100%** |

The usual structure is followed by 81% of subjects. The following rows in the table quantify occurrence of “other” topics that are not related to syntax and usually cover knowledge from other fields. A total of 38% of subjects include web page accessibility topics. In the Czech Republic, this problematic is exactly set by the Czech law (365/2000) for public sector organizations and it is often followed by business sector as best practice. Therefore, there is not much space for customization. None of the other topics are represented frequently as they occur in less than 25% of cases: 24% Search Engine Optimization (SEO) and Pay-Per-Click advertisements (PPC) bringing actual visitors to websites, 19% CMSs utilizing existing solutions, 14% user testing and 10% statistics representing feedback mechanism.

Some universities don't include requirements for credits in their curricula. Therefore, it was not possible to quantify this point. However, it has been found that some universities do not request the creation of a website as the output from the subject, or such projects have only marginal impact on students' results. The four subjects not following the usual structure have been analysed in detail. One of them starts the curriculum with website planning and project management, follows with the conception of websites and optimization, and leaves the HTML syntax as the last topic. Another three subjects focused on web development using CMS, including HTML syntax on the top of that.

Besides the quantitative analysis, some points have been noted. The Czech academic pioneer of computer science, the Faculty of Mathematics and Physics at Charles University, offers no subject related to web development. One university offers a study programme called 'web engineering'. However, it provides no subject that could be included in this research as all the subjects are highly specialized. One university offers a total of 17 subjects related to web development, ranging across more faculties (three were chosen into this research).

Private universities were not included in the research for two reasons. Their quality of teaching varies highly. Only 11% of Czech students study at private universities, although their number is twice the count of public universities. Although the private universities were not included in the main analysis, some curricula were read and in some cases the private universities offer web development subjects in the form of project management including knowledge from other related fields.

## 5. Discussion

In business, websites are considered open systems, as defined by Bertalanffy, though developers, owners, and users may not be aware of this term. The approach by the professionals can be defined as synthetic, perceiving surroundings, relations and influencing. Their approach exploits existing solutions (CMS) and knowledge (marketing). It is focused on creating strategy, not syntax. One of the core points in business is **a user** whose behaviour is measured and evaluated. Often, for large projects, agile software development is used (Alla and Fitzgerald, 2013). Also Nerur (2010), mentioning Bertalanffy, says: *'We contend that the underlying assumptions of ADM (Agile Development Methods) are not novel in any sense. Concepts such as iterative development, learning, self-organization, reflective practice, self-directed teams and stakeholder participation, to name but a few, have evolved separately in other disciplines, and one or more of them were used in some form in software development as well.'*

According to our analysis, the most common approach of teaching web development is to divide subject content into small independent topics ordered chronologically by their age as they appeared for the first time. This sequence of topics is very similar to the eight evolutionary stages of the Web introduced by Bartůšková and Krejcar (2014), but the curricula usually include only the first three stages (that is, static website, interactive website and dynamic website). Such subject organization can be considered a heap that is defined by GST as a collection of similar, barely related items in contrast to a system. However, *'Web design does not live on its own planet. It's connected to the rest of the world'* (Miller, 2011). A curriculum creation seems to be usually done by using a reductionist and mechanistic approach. As a result, some topics should not be included because they are:

- of little use (HTTP theory, definition lists),
- separately useless (forms), or
- trivial (some CSS definitions).

Students are not taught to make reasonable choices when selecting technologies and formatting. Topics closer to both reality and GST are not often taught. If they are, they are usually planned for the last sessions as something extra. However, in the real world, they represent the basics of the project and should be remembered in the whole process of website development.

This research can be criticized for several reasons. In this part, we try to discuss more obvious concerns.

- *A curriculum is only a plan, not dogma, and can be customized and improved by a teacher*. Research doesn't see the reality in classes. The problem is that the curriculum says how a university wants the subject to be taught. Yes, it can be improved, but this is not guaranteed, it is only a coincidence. Moreover, the results of the analysis are very significant and slight improvements do not change results.
- *In some cases, only the syntax needs to be taught.* Yes, this is needed for some highly technical professions. However, this problem is present in almost all universities including business studies. Every business needs a website. Most of them hire a professional, or use a CMS system. These people do not create the syntax, but they would utilize knowledge of the web development's overall process. Concerning the professionals, they do need to know the syntax, but the other knowledge as well.
- *An excellent professional needs to know the background and details of the web thoroughly (including syntax)*. Yes, this is true. However, we haven't asked whether it is possible to produce a web professional in a university. We researched what is the content of compulsory, most usual and basic subjects presented to the majority of students.

## 6. Conclusion

Concluding our results, we can say Czech public universities don't set up their curricula for teaching web development in the desired way, ignoring real business needs. One of the reasons might be because they avoid the principles of GST when building a curriculum. This is a paradox because GST was introduced by the academic world. The very same problem is experienced throughout the whole education system, regardless the subject, level, or country. E.g. Tynjälä et al (2006) suggest that 'the dual mission of university education to prepare students both for scientific thinking and for working life requires integration of teaching and research, and integration of theory, practise and self-regulative skills'. In this paper, we proved the existence of this problem regarding the teaching of web development. We also mentioned some possible consequences, e.g. the existence of many low-quality websites. According to the authors' experience, the web development topic attracts little interest from academia. Involving GST principles in web development teaching could make it more attractive to academicians and this in turn could make the subject more useful for all students.

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# Evaluation of an Automatic Question Generation Approach Using Ontologies

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**Abstracts:** Advancements in Semantic Web techniques have led to the emergence of ontology based question generation. Ontologies are used to represent domain knowledge in the form of concepts, instances and their relationships as their elements. Many research strategies for generating questions using ontologies have been proposed but little work has been done on investigating whether an ontology is an appropriate source of data for question generation. Since there is no standard guideline for developing an ontology, the representation of ontology elements might vary in many ways, and this paper aims to investigate how the naming of ontology elements would affect the questions generated. In order to achieve this aim, two research questions will be investigated which are: how many correct questions can be generated from an ontology, and what are the reasons for incorrect questions being generated. Categorized question templates and a set of question strategies for mapping templates with a concept in an ontology are proposed. A prototype has been developed with a *Reader* to read data from input file and 3 question generators namely *termQG, ClassQG and PropertyQG* to generate questions for 3 ontological approaches. After questions have been generated, the number of correct questions generated is calculated and the reasons for incorrect questions are identified. Two ontologies have been used, an Operating System Ontology and a Travel Ontology. Twenty question templates from three question categories – *definition, concept completion* and *comparison* – together with 5 question generation strategies have been used in this evaluation. Results shows that more than half of the questions generated are correct and there are 3 distinct reasons why incorrect questions may be generated. The main contribution to incorrect question generation was inappropriate naming of ontology elements where 4 distinct categories are further identified. In addition, evaluation shows that the object type should be considered when designing question templates. Furthermore, the evaluation indirectly shows the effectiveness of the ontological approaches for generating questions from a real-world ontology.

**Keywords:** question generation, ontology, ontological approaches, assessment, question template

## 1. Introduction

Recently, machine generated questions research have been widely studied. Developing automatic methods for Question Generation (QG) can alleviate the burden of both traditional and e-Learning assessments. Unstructured text and ontologies are two sources that are typically used for QG.

Advancements in Semantic Web technologies have led to the emergence of ontology based question generation. Reasons for question generation include formative and summative assessment (Papasalouros et al., 2008, Mitkov et al., 2006), exercise questions (Lin and Chou, 2011), problem solving questions (Kumar, 2005), domain specific general questions (Soldatova and Mizoguchi, 2009), or general questions (Hovy et al., 2001). Different strategies have been used to transform semantic information from an ontology into questions. The system proposed by Afzal and Mitkov (2014) uses three strategies to generate Multiple Choice Questions (MCQs) from a domain ontology which are class based strategies, property based strategies, and terminology based strategies. OntoQue (Al-Yahya, 2011, Al-Yahya, 2014) claims to be using a semantic based approach where it uses knowledge in the ontology about domain entities, such as classes for MCQs and true/false, properties for fill-in the blank (FIB) questions, to generate semantically correct assessment items. Papasalouros et al. (2008) have introduced three approaches for ontology-based single response MCQ generation which are class based, property-based and terminology-based.

Most of the works on ontology QG have applied similar ontological approaches for generating questions (class-based, property-based and terminology-based) and look mainly into how to generate distractors for MCQs and similar types of questions. Therefore, in our research we aim to explore factual question generation for short/long answer types of question using the same approaches. As a first step to achieving this aim, we investigate whether an ontology is an appropriate source for generating questions automatically. For this purpose, we will investigate the following research questions:

- How many correct questions can be generated from an ontology?
- What are the reasons for incorrect questions being generated?

The discussion in this paper will begin with a discussion of related works on QG in section 2. Section 3 discusses the method undertaken to conduct this experiment and the last part discusses the results obtained from the evaluation.

## 2. Question generation (QG)

### 2.1 What is a correct question?

A question is a sentence that uses to make a request of information. In English, there are three types of sentences: simple, compound and complex. A simple sentence usually has basic elements, including a subject, a verb and a clear meaning. A question Q is a type of sentence that is made up from 3-tuples which are question word (QW), predicate (P), and key element (KE).

A Question Word is a keyword used to indicate the type of information needed, a Predicate is the verb to express the action of the subject, and subject is normally a noun in a sentence. For example:

1. "What is an operating system?"
   *QW: What*
   *P: is*
   *KE: Operating System*

2. Explain the advantage of Shortest Job First algorithm."
   *QW: Explain*
   *P: the advantage of*
   *KE: Shortest Job First algorithm*

3. In the context of memory management, what is address binding?
   *QW: In the context of…. what*
   *P: is*
   *KE: memory management, address binding.*

A correct question can be defined as question that has no ambiguity and the question word is suitable to be used with the concept for generating the question.

### 2.2 Question taxonomies

Graesser and Person (1994) have divided questions for a tutorial into four categories: questions with *short answers,* questions with *long answers, assertions*, and *requests or directive questions*. Short answers are further classified into several subcategories which are: *verification, disjunctive, concept completion, feature specification* and *quantification*, whereas long *answers* are classified into *definition, example, comparison, interpretation, causal antecedent, causal consequence, goal orientation, instrumental/procedural, enablement*, and *expectation judgemental*. The authors claim the last 5 question types from the list are highly correlated with the deeper level of cognition in Bloom's taxonomy. The authors also suggest three question types- *pumps*, *hints*, and *prompt*s - that bind with low, medium and high levels of specificity (Graesser, 1995). Olney, Grasser and Person (2012) proposed three questioning strategies which are *contextual verification*, *forced choices*, and *causal chain*. Both contextual and forced choice questions use features extracted from two related concepts for generating question stems.

Bodoff and Raban (2015) adapt the question classification by Graesser and Person for investigating relationships between question types, elicitations and fees that are paid for mediated search services. They consider only four categories of the Graesser and Person (1994) taxonomy due to the kind of questions encountered in their data sample. Apart from the four categories – concept completion, enablement, instrumental/procedural, and quantification – a new *identity* question type was introduced which was found to be reliable in predicting elicitation and fees.

The web-based collaborative argumentation system proposed by Le et al. (2014) is another example of a recent question generation application that uses Graesser and Person's question classification. This work proposed a technical approach to assist students in understanding a given discussion topic by means of generating questions for argumentation with the use of semantic information. This work employed syntax-based, template-based and semantic based approaches where WordNet and Wikipedia are used to provide the semantic information to generate semantic question. Question templates are defined according to Heilman (2011) and are constructed for each of 9 categories as defined by Graesser and Person. Each placeholder in the question template is replaced with a noun or noun phrase from a discussion topic. The question categories enable the overall topic to be covered for argumentation.

### 2.3 Ontologies for QG

The notion of ontology, present within Artificial Intelligence (AI) research, focuses on the conceptualization or categorization process, prior to the actual building of a knowledge base. The continuous growth of the web that has integrated with business and personal life has caused ontology research to focus on the web. The Paper on 'Ontology Development 101' (Noy and McGuinness, 2001) mentions several reasons why ontologies are needed in the web. According to Noy and McGuinness, an ontology is a formal specification of conceptualization (Gruber, 1993) that can be used to share and enable reuse of domain knowledge.

Recent research has led to the emergence of ontology based QG. The reasons for QG include formative and summative assessment (Papasalouros et al., 2008, Mitkov et al., 2006), repetitive exercises (Lin and Chou, 2011), problem solving (Kumar, 2005), domain specific questions (Soldatova and Mizoguchi, 2009), and general questions (Hovy et al., 2001).

Substantial research efforts are being made in the generation of ontology based MCQ item generation. They define new strategies to identify key answers and distractors for MCQs. Text similarity measures and ontology elements are measured to identify keys and distractors (Cubric and Tosic, 2011), and an item that has the highest similarity will become the key answer and an item with a lower similarity index is chosen as a distractor for the MCQ. Key answers can also be selected from an RDF object and the distractors selected randomly from a collection of items under the same class as the key (Al-Yahya, 2014).

The proposed approach generates questions according to a specified ontology represented in OWL and hence can be used to generate questions for different ontologies as compared to a template based approach that might restrict the choice of question to be asked. Results from experiments have showed that class-based and terminology based approaches provide better syntactically correct questions but produce fewer questions compared to property based questions. The work focuses on creating the correct (key answer) and incorrect statements (distractors) for MCQs question that only asked 'Choose the correct sentence'.

Another engine that is capable of generating MCQs using a domain ontology is OntoQue (Al Yahya, 2011). Besides MCQs, the system is capable of generating true/false and FIB styles of questions. OntoQue has said to be using a semantic based approach where it uses knowledge from the ontology about domain entities such as classes for MCQs and true/false, and properties for FIB questions to generate semantically correct assessment items. Most questions generated are reported to be classified as good questions based on high precision data obtained experimentally. However the majority of questions constructed using this system are at the first level of Bloom taxonomy. MCQ stems are formulated by asking the instance of the class only and the key taken from the object of the statement.

## 3. Method

### 3.1 Generate question templates

In order to generate question templates, first a total 0f 259 questions from an Operating System textbook (Silberschatz, Galvin and Gagne, 2012) were collected and analysed. For this evaluation, we only selected factual question of three categories from the Graesser and Person Taxonomy which were *definition, concept completion* and *comparison*. After classifying the question, we proceeded with formalizing the questions using predicate logic to obtain question patterns. This process is called *semantic interpretation of questions into formal representation*. During this process, each key element from a sentence is extracted and replaced with a placeholder to create question stems. After that, we remove any duplicate pattern of question stems and identify a list of categorized unique templates as in Table 1.

**Table 1**: Categorized question templates

| Category | Template |
|---|---|
| Definition | Define [X].<br>What is [X]?<br>What does it means by [X]?<br>What is a [X] in [SC]?<br>Define a [X] in [SC]?<br>In the context of [SC], what is [X]?<br>What is meant by the term [X] in a [SC]? |
| Concept Completion | Explain the term [X].<br>Discuss what is [X].<br>Within the context of [SC], explain the term [X].<br>What [P] [X]?<br>Explain [P] [X].<br>In the context of [SC], what [P] [X]? |
| Comparison | Differentiate between [X] and [Y].<br>What is the difference between [X] and [Y]?<br>How does [X] differ from [Y]?<br>Describe the differences between [X] and [Y].<br>Compare between [X] and [Y].<br>With regards to [SC], explain the difference between [X] and [Y]. |

Notes: [X] and [Y] is a concept. [SC] is a superclass of [X] or [Y]

## 3.2 Generate question strategies

This process was conducted before we removed the duplication in the question templates. We took the list of question stems and identified how each key element in the questions is represented in the ontology and how one key element relates with another by checking the relationship that exists between relevant matching concepts in the ontology. Next, we used three ontological approaches proposed by Papasoulourus et al. (2008) in this evaluation and categorized our question template accordingly into these approaches. In order to fit the questions into the approaches, we proposed a set of strategies in which each of the strategy is defined as follows:

<u>Term Based Approach</u>
Strategy 1: Concept only

- The question can be generated if there is a concept C which exists in an ontology.

<u>Class Based Approach</u>
Strategy 2: Is-a relation

- The question can be generated if a concept C1 is a subclass of another concept C2 which exist in an ontology.

Strategy 3: Cross relation

- The question can be generated if there is a concept C1 that is subclass of concept C and concept C2 is also a subclass of concept C which exists in an ontology.

<u>Property Based Approach</u>
Strategy 4: Term + Property

- The question can be generated if there is a concept C that has object property P which exists in an ontology.

Strategy 5: Class + Property

- The question can be generated if there is a concept C1 that is related to concept C2 by object property P and which exist in an ontology.

Table 2 shows the results of further classification of question templates into the three ontological approaches. As shown in the table the first approach is for questions with only one key element. The second approach is for questions with more than one key element but for this evaluation we only consider two key elements to reduce the complexity of identifying relations in the ontology. The third approach is for questions with predicates other than 'is' or 'are' as these predicate we assume are already represented as hierarchical relations in the ontology.

**Table 2:** Further classification of question templates

| Approach | Category | Template |
|---|---|---|
| Term-based | Definition | Define [X].<br>What is [X]?<br>What does it means by [X]? |
| | Concept Completion | Explain the term [X].<br>Discuss what is [X]. |
| | Comparison | *[no template]* |
| Class-based | Definition | What is a [X] in [SC]?<br>Define a [X] in [SC]?<br>In the context of [SC], what is [X]?<br>What is meant by the term [X] in a [SC]? |
| | Concept Completion | Within the context of [SC], explain the term [X] . |
| | Comparison | Differentiate between [X] and [Y].<br>What is the difference between [X] and [Y]?<br>How does [X] differ from [Y]?<br>Describe the differences between [X] and [Y].<br>Compare between [X] and [Y].<br>With regards to [SC], explain the difference between [X] and [Y]. |
| Property-based | Definition | *[no template]* |
| | Concept Completion | What [P] [X]?<br>Explain [P] [X].<br>In the context of [SC] , what [P] [X]? |
| | Comparison | *[no template]* |

Notes: [X] and [Y] is a concept. [SC] is a superclass of [X] or [Y]

## 3.3 Preparing data input and design knowledge base

There are two data inputs used for this experiment which are ontologies and further categorised question templates. Both data inputs are stored in the form of text files. For ontologies, triples are extracted from an ontology in the form of "Concept#1 is-a Concept#2", while the question templates are written in the form as in Table 2 for the ontology's concept instantiation later.

## 3.4 Design and code algorithm

There are four components in this system: *Reader*, *TermQuestionGenerator ClassQuestionGenerator* and *PropertyQuestionGenerator*. Figure 1 shows the system architecture which includes three components for question generation in the Question Generator and one for reading data from the data file.

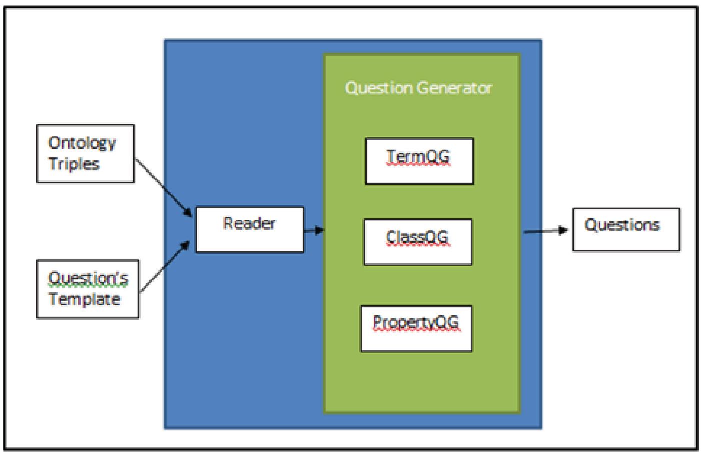


**Figure 1:** System architecture

### 3.5 Generate question for different ontology

There were 2 ontologies used for this evaluation: Operating System Ontology (OSO) (Silberschatz, Galvin, and Gagne, 2012) and Travel Ontology (TO) (Knublauch, 2004). The OSO contains 97 concepts and TO contains 41 concepts. OSO is the top level ontology with only hierarchical types of relation and TO is a descriptive type of ontology with hierarchical type data structure and object properties.

### 3.6 Evaluation

The evaluation was conducted and the results reported using simple statistical calculations. First, the generated questions were analysed to determine correct and incorrect questions. At the same time each incorrect question was provided with a reason. Finally, all the incorrect questions were categorized based on the pattern of the identified reasons.

The next section will discuss the results obtained from this evaluation in twofold, which are:

- The numbers of correct questions generated;
- The reasons why incorrect questions were generated (if any).

## 4. Results

### 4.1 How many correct questions can be generated from an ontology?

Table 1 shows the numbers of total questions generated from both ontologies with OSO generating three times higher numbers of question compared to TO even though the number of concepts in OSO is only double those in TO.

**Table 3**: Numbers of question generated

| Ontology | Ontology elements | Number of questions generated by category | | | Total of Question Generated |
|---|---|---|---|---|---|
| | | Definition | Concept Completion | Comparison | |
| OSO | C: 97<br>HR: 86<br>OPR:NA | Term: 97<br>Class: 86<br>Property: NA | Term: 97<br>Class: 86<br>Property: NA | Term: NA<br>Class: 198<br>Property: NA | 564 |
| TO | C: 41<br>HR: 26<br>OPR:31 | Term: 41<br>Class: 26<br>Property: NA | Term: 41<br>Class: 26<br>Property: 31 | Term: NA<br>Class: 17<br>Property: NA | 182 |

Figure 2 shows the percentages of correct questions that can be generated from ontologies where OSO gives more promising results compared to TO. OSO shows a higher percentage of correct questions in the first two question categories, namely definition and concept completion, but a slightly lower percentage compare to TO in the third question category, comparison. The result from this experiment has shown that more than three quarters of incorrect questions generated from both ontologies are due to incorrect naming of concepts. We list all the reasons of incorrect naming and organize them into five categories in the following subsection.


**Figure 2:** Percentages of correct question generated

## 4.2 What are the reasons for incorrect questions generated?

The result from this evaluation shows 3 main reasons for incorrect question generation which are:

- Inappropriate representation of a concept's name;
- Inappropriate use of question templates;
- Inappropriate representation of object properties.

Details of each reason are discussed in following subsection.

### *4.2.1 Inappropriate representation of a concept's name*

Four different subcategories are identified, and the following discusses each of the categories with examples, why it causes problems and possible solutions.

### *4.2.2 Name of the concept is too long.*

Example:

*interaction-between-processes-and-o-s in process-and-thread-management*

Why it causes problems:

This kind of naming will give too much information in one concept. It will be difficult to control and to reason about. It creates problem to generate questions as this representation include nouns as well as action verbs in one word. For example, if we generate question using strategy 1, it may generate for example:
"Define *interaction-between-processes-and-o-s in process-and-thread-management".*

Possible solution:

Use simple names for concepts.

### *4.2.3 A concept name contains two or more nouns.*

Example:

*O-s-services-and-components*

Why it causes problems:

This kind of naming will introduce ambiguity as we are not sure of which concept is the key element for the question. For example, if we generate a question using strategy 1, it may generate:

"*Define o-s-services-and-components*."

Possible solution:

Use single concepts by splitting the compound concept into two.

### *4.2.4 Repeating the word used for sub and super concept.*

Example:

***Security** problem is-a **security***

Why it causes problems:

Although it is not wrong to represent concepts in this way, but by applying the proposed strategies it will generate redundant words in the question. For example:

*"Explain security problems in security"*

It would be better rephrased as:

*"Explain problems in security"*

Possible solution:

As the superclass already mentioned is about 'security', it is understood if the subclass only uses the word 'problem'. Alternatively, we can eliminate keywords that already exist in the superclass in the code.

*4.2.5 Naming of concept includes action verb.*

Example:

*Implementation-of-access-matrix*

Why it causes problems:

This kind of word is not suitable for naming concepts. Normally a concept will use a noun or noun phrase for representation. When we try to instantiate a definition type of question template that has pattern "Define [X]." it will give:

"*Define implementation-of-access-matrix."*

However, if we represent the concept using noun (access-matrix) and action verb (implementation-of) as object properties then we get questions like "*Define access-matrix*." by using Strategy 1 and "*Explain the implementation-of access-matrix*." by using Strategy 4.

Possible solution:

The action verb is more suitable to be used as an object property instead of combining with a concept word.

*4.2.6 Inappropriate use of question templates*

In contrast, the incorrect questions generated from TO are not limited to inappropriate ontology representations but also due to other aspects. For example, in TO there is a concept name 'Sydney' which is unsuitable to use a definition type of question as people normally do not ask the definition of a location. The most appropriate question word for location would be 'where', and this will change the category of question to concept completion. From this result, we can conclude that the question word must depend on object type and thus each question word might only be suitable for certain question types. For example, a question like 'Define Sydney' or 'Define Hotel' uses an incorrect question word, and in this case the question word should be replaced with 'Where is'.

*4.2.7 Inappropriate representation of object properties*

In addition, inappropriate word use for an object property will affect the meaning of the question that will be generated. For example, the triple 'beach has-a Sydney' in TO sounds semantically incorrect and a question generated like "What beach has-a Sydney?" from this triple will automatically be incorrect. It will change the meaning of the sentence. It will be appropriate if the object property has been changed to *is-in* instead of *has-a*. Therefore, appropriate names of object properties are as important as concept names to provide semantically correct representations.

## 5. Discussion

Overall, the investigation shows promising and satisfactory results when used with OSO. Most of the incorrect questions were due to inappropriate names to represent the concepts. This problem is reduced if the ontology representation uses a proper naming convention. On the other hand, the evaluation shows satisfactory results when used with TO. This is due to the question template having unsuitable object types for the concepts in TO. There are four different object types which bind correctly with suitable question words: *entity (what), location (where), people (who)* and *time (when).* OSO mainly represents concepts using entity object types, while TO has a combination of entity and location. The question templates used in this evaluation work well with the entity type of object.

In addition, the OBO Foundry Ontology (OBO Foundry, 2009), has proposed a set of naming conventions to help ontology developers and users to avoid flaws and inaccuracies when editing, matching and also help to reduce readability problems. The results from this experiment have shown that inappropriate naming of concepts in ontology also results in incorrect question generated. The suggestion is to use explicit and concise names which are kept short and memorable, but precise enough to capture the intended meaning. The result from the experiment shows this to be the most frequently occurring problem resulting in incorrect questions generated.

As a conclusion, we conclude that the experiment result has shown that the approach as well the strategies proposed are able to generate correct questions provided the ontology elements use proper and concise names or follow naming conventions suggested by the OBO Foundry. We also found that the object types should be identified during question template generation to indicate what question words are suitable for the concepts. The results can be improved by finding the solution for the errors found in this evaluation.

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# Enhancing Language Learner Autonomy: Through ePortfolio Use

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**Abstract:** Nowadays, in compliance with the so-called 21st century skills, it is desired to provide our students with skills needed to become successful, autonomous, and reflective practitioners. Implementation of ePortfolio in the learning process seems to be a feasible solution to the above mentioned challenge. The aim of the author's research is to examine the potential of ePortfolio use in language learning at tertiary level. The paper describes a pilot study of a course design enhanced by ePortfolio application and piloted in university students of English for Specific Purposes and the University of Pardubice, Czech Republic. 40 students of English for Economics and English for Chemistry are involved in the initial phase of the study with the aim to provide language learners with space for self-analysis and self-reflection followed by blended form of guided autonomous learning and subject learning. The study participants undergo several stages of language level assessment. Firstly, it is an initial ePlacement test; consequently, students go through self-assessment of their skills followed by standardized language testing. The results of tests are shared and discussed with the students with the focus on strong and weak skills. Each phase is concluded by setting learning objectives based on obtained test results and self-assessment forms. The process aims at formulation of partial, concrete, and achievable learning objectives. The main functions of portfolio are all present in the study phases: evaluation, growth, and showcasing functions. The ePortfolio represents both the role a personal learning space and simultaneously of a space designed for collecting artefacts which provide evidence of met objectives. The suggested teaching and learning model using ePortfolio to enhance reflection and autonomy in learners can be adjusted and applied in teaching and learning subjects of various fields thus increasing the learning experience and outcomes in the learning process.

**Keywords:** ePortfolio, digital portfolio, self-reflection, self-assessment, autonomy, language learning, higher education, ELT, pilot study

## 1. Introduction

Use of portfolio in language learning has been in existence since 1991. It was proposed by David Little (Little, 2011) and a team of language specialist as a European Language Portfolio (ELP) and between 1998 and 2000 it was launched throughout Europe by the Council of Europe. European Language Portfolio was perceived as follows "The Principles and Guidelines insist that the ELP is the property of the individual learner, which in itself implies learner autonomy." (Little, 1991). Despite an elaborate structure of the document and its mission not distant from the current trends including lifelong learning encouragement, transparency of learning, promotion of plurilingualism, and learner autonomy, the file consisting of a language passport, a language biography, and a dossier did not seem to be widely accepted and implemented in language teaching and learning. Twenty-five years later the same ideas are being promoted by technology experts worldwide encouraging use of ePortfolio across the fields and across the education levels claiming with similar arguments of lifelong learning, employability, and visualization of learning. One of the most frequent arguments for ePortfolio implementation today is its role in providing evidence of individual growth and personal accomplishments increasing user employability be it students or experienced employees searching for new jobs nationally or internationally.

## 2. The Role of ePortfolio in Language Learning

What is electronic portfolio? EPortfolio can be described as a collection of digital artefacts. Digital artefacts can comprise of, for instance, electronic documents, video, audio files, and images, etc. which serve as examples of student work and evidence of their learning over time. The artefacts should be collected and then selected with purpose and their assortment in collections should be justifiable. ePortfolio is usually introduced by the institutions as a form of learning assessment. According to Barrett "portfolio assessment" in education was introduced in late 1980s with the emphasis on assessment itself (Barrett, 2007). Paulson & Paulson outlined contrasting paradigms of two models of portfolio assessment: Positivist and Constructivist paradigms. These portfolios then produce different activities.

Positivist Portfolios "The purpose of the portfolio is to assess learning outcomes and those outcomes are, generally, defined externally. Positivism assumes that meaning is constant across users, contexts, and purposes… The portfolio is a receptacle for examples of student work used to infer what and how much learning has occurred." (p.8)

Constructivist Portfolios “The portfolio is a learning environment in which the learner constructs meaning. It assumes that meaning varies across individuals, over time, and with purpose. The portfolio presents process, a record of the processes associated with learning itself; a summation of individual portfolios would be too complex for normative description.” (pp. 8-9)

The ePortfolio was first introduced at the Language Centre of the University of Pardubice as a positivist portfolio. The students were and still are assigned tasks to be completed and displayed within their ePortfolio to be subsequently assessed according to given criteria. With the pilot study described in detail in chapter 5, constructivist portfolios were introduced to a team of involved teachers and their students. The aim of the pilot study is to enhance self-assessment and autonomy in students. These two phenomena will be further discussed in the following two chapters.

## 3. ePortfolio and Self-assessment

Assessment trough ePlacement, Progress, and Final Evaluation tests has been used by the Language Centre of the University Pardubice for several years. There are standardized tests allowing the department to place their students according to their current language level thus enabling the students to work on their progress more efficiently aiming at higher level achievement according to CEFR. Incorporation of self-assessment into the courses comes naturally with introduction of the ePortfolio in both ‘English for Specific Purposes’ and ‘English for Academic Purposes’ courses. In the pilot study students undergo a self-assessment cycle including setting goals and evidence collection during a time period of one term starting with the ePlacement test as demonstrated in the following scheme (Figure 1).

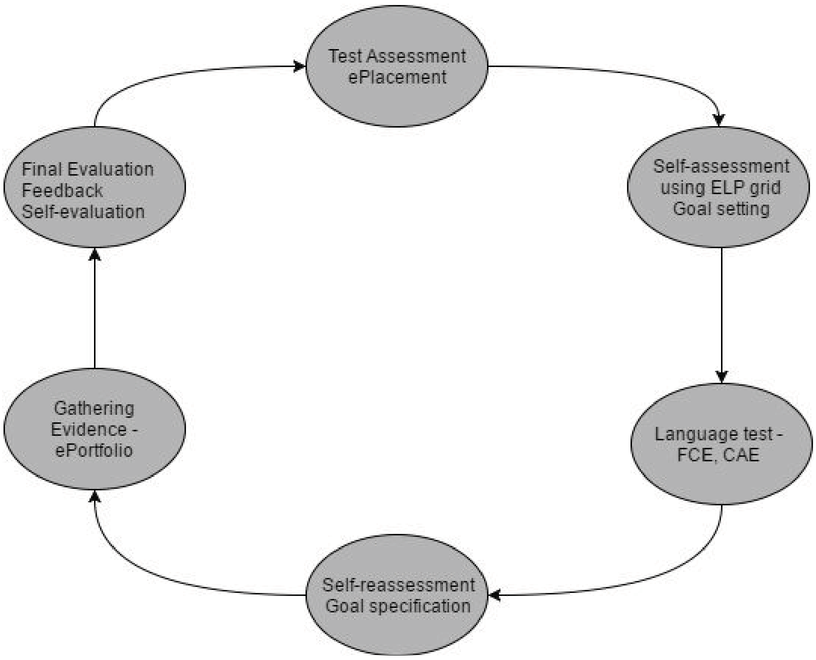


**Figure 1:** Self-assessment and Assessment cycle

## 4. ePortfolio and Autonomy

The concept of autonomy in language learning can be tracked back to the first European Council projects and research centres established in 1971. One of the prominent figures within the field of autonomy is Henri Holec. One of his earliest definitions describes autonomy as ‘the ability to take charge of one’s own learning’ (Holec 1981) meaning that the responsibility for the learning is taken by the learners themselves by determining the learning objectives, selecting methods and techniques of achieving the objectives and finally by evaluating what has been acquired (Benson 2013). The above mentioned principles of learner autonomy were applied when conducting the pilot study on self-assessment and portfolio implementation in language learning. According to Benson ‘Portfolios have also been seen as a useful tool for self-monitoring and self-assessment’ especially for student teachers, however, ‘research shows that learners are, under appropriate conditions and with appropriate training, able to self-assess their language performance, but it does not yet tell us much about how they make the process of self-assessment relevant to their own learning goals.' The pilot study was run to test feasibility of the suggested teaching and learning model.

## 5. Pilot Study

### 5.1 Purpose of the Study and Research Questions

The primary purpose of the study was to pilot a proposed model of language teaching and learning and to find answers to the following questions: Can ePortfolio be successfully applied to enhance efficient language learning? Are students capable of self-assessment? Are they capable of self-assessment in the target language? Are students able to set their own language learning goals and further provide evidence of their fulfilment? How do students informally learn foreign languages?

### 5.2 Pilot Study Description

There were 3 language teachers and 48 students participating in the first pilot study of the ePortfolio implementation with accent on self-assessment and learner autonomy enhancement. All three teachers are experienced users of Mahara ePortfolio tool with more than 2 years of practice in implementation of positivist portfolio in language teaching and learning. The students were selected according to two criteria: smaller groups of students were involved allowing individual approach to students. All three levels of tertiary education where English for Specific Purposes (ESP) or English for Academic Purposes (EAP) courses are offered were included. Another criterion for the participant selection was the language level. The teachers agreed on selecting the groups which are already expected to be capable of using the target language on the level required for self-analysis and also the participants were expected certain ability to work as independent language learners. For the above mentioned reasons, the levels of English language beginning with B1+ were included in the study. The participants of the pilot study were from two faculties of the University of Pardubice: Faculty of Chemical Technology and Faculty of Economics and Administration. The pilot study was designed for a period of one term and it was in progress from the end of February to the end of June 2016 covering 5 months including the teaching and examination period at the University of Pardubice.

### 5.3 Research Methodology

The core of the research lies in quantitatively qualitative research. In the first phase the students are tested using standardized language tests and data from the tests is processed and analysed. The second phase of the research consists in evidence collection and in in-depth interviews. The aim is to obtain detailed data about student language level, their competencies concerning goal setting, autonomous learning, and evidence collection all placed in the context of self-assessment and self-reflection. As it was mentioned above, the model was piloted by three teachers to increase credibility of the study and in order to obtain peer de-briefing which was acquired continuously throughout the pilot period and in a final consolidated form at the end of the term. The first phase of the study fulfilled the aim to verify the feasibility of the model and data for further analysis was collected. To assure reliability of the research and data, the study is going to be repeated. The consistency is to be achieved by using the same questions in the final self-assessment and assessment session conducted with the students. The final sessions are recorded, transcribed, and coded using the software ATLAS.ti.

### 5.4 Language ePortfolio Implementation Process

Firstly current language level of the students of both Bachelor and Master levels was diagnosed by means of a standardized institutional ePlacement English test and consequently students were enrolled in the language courses according to their level of English using CEFR. The courses currently offered by the Language Centre range from A2+ to C1 courses. Only the students of doctoral level do not undergo the initial placement procedure due to a different nature of their study which to the largest extend corresponds to the character of autonomous learning. The students in selected courses were assigned a language self-assessment and goal-setting task based on the CEFR can-do-statements grid. Subsequently the students were tested using one of the tests in compliance with their level determined by the ePlacement test. The tests can be seen in Table 1:

**Table 1:** Language tests and CEFR levels

| Language Test and CEFR Levels | |
|---|---|
| CEFR level<br>Reading | Standardized Language Test<br>EEWnglish<br>Total |
| A2 | KET *(A Cambridge English: Key)* |
| A2+/B1 | PET *(A Cambridge English: Preliminary)* |
| B1+/B2 | FCE *(A Cambridge English: First)* |
| B2+/C1 | CAE *(A Cambridge English: Advanced)* |

The individual tests needed to be adopted in length, nevertheless, in all tests three language skills were included: Listening, Reading, and Use of English. Writing skill was excluded due to consistency with the ePlacement course and specific focus of the selected ESP courses. However, the self-assessment template also included the Writing skill to provide students with complex self-assessment criteria and furthermore taking into account informal language learning of students. In accordance with the Self-assessment cycle illustrated in Figure 1 the students together with their teachers revisited their Self-assessment Pages in their ePortfolio and reassessed their skill analysis and their personal objectives reflecting their language test results in each tested skill. The students consulted their goals and weaknesses with the teachers. The final part of the term was spent on skill improvement in and out of the language course and consultations on possible ways of self-improvement in a form of short guided sharing sessions among the students. The pilot study was concluded with the final self-evaluation and evaluation phase which composed part of the language exam and consisted of a presentation of learning evidence gathered by the students.

## 6. Results and Discussion

### 6.1 Goal-setting and Language Analysis

The pilot study was successfully carried out and concluded by all three teachers including the author of this article. All teachers together with their students went through all stages of the Self-assessment and final assessment cycle suggested in Figure 1. There were determined two key moments in the study. The progress test analysis revealing both students and teachers the areas for improvement and the goal-setting phase in which the students encountered difficulties creating general non-achievable goals with guided progress to tangible and achievable objectives. Example of goal-setting progress can be seen in Table 2 where the process of clarification of the goal can be observed and Table 3 outlines average results of the standardized tests from Table 1 which were administered in all selected courses. These test results provide both teachers and students with valuable information about the strongest and weakest skills in students across the levels and programmes. The outcomes show that the strongest skills of the students are Reading and Listening and the weakest skill is Use of English. After the testing and further test result analysis, the Use of English was the most requested part to be practiced by involved students.

**Table 2:** Goal-setting phase

| Examples of goal-setting and goal-resetting phases | |
|---|---|
| **Goal 1**<br>Reading | **Goal 2 (reconsidered and reformulated)**<br>EEWnglish<br>Total |
| *I want to be better in listening.* | *I want to watch one video per week.* |
| *I need to improve my grammar.* | *I will write sometimes a text and that will help me in terminology and grammar.* |

**Table 3:** Language Skill Analysis

Table 3 is divided into 5 partial tables according to educational levels and CEFR levels of the students. The data in percentage demonstrate average results in each group and the grey fields show the strongest and weakest skill identified in each piloted group. These results can be further investigated and used in course design and language policy decisions.

**Bachelor level**

| Skills analysis on B1+ target level: total of 7 Ss (1st year) | | | |
|---|---|---|---|
| Listening | Reading | Use of E | Total |
| 83% | 72% | 73% | 78% |
| Skills analysis on C1 target level: total of 8 Ss | | | |
| Listening | Reading | Use of E | Total |
| 58% | 85% | 56% | 67% |

**Master level**

| Skills analysis on B1+/B2 target level: total of 12 Ss | | | |
|---|---|---|---|
| Listening | Reading | Use of E | Total |
| 55% | 39% | 45% | 49% |

| Skills analysis on B2+ target level: total of 9 Ss | | | |
|---|---|---|---|
| Listening | Reading | Use of E | Total |
| 55% | 65% | 54% | 57% |

**Doctoral level**

| Skills analysis on C1 target level: total of 12 Ss | | | |
|---|---|---|---|
| Listening | Reading | Use of E | Total |
| 45% | 60% | 38% | 47% |

### 6.2 Self-Assessment and Evidence

The final phase of the Self-assessment and Assessment cycle consists of evidence presentation, overall self-assessment and final teacher's assessment. The students prepare, share, and present a Self-assessment and Evidence Page created in their ePortfolio using the Mahara ePortfolio tool. The self-assessment page can be shared only with the teacher and its design allows teacher to see changes made to the page in real time. The Page structure can be seen in Figure 2. The Page is designed covering all assessed skills: Listening Comprehension, Reading Comprehension, Spoken Interaction, Spoken Production, and Writing. All these skills are assessed by the students themselves using can-do-statements from the template and by their means defining strong and weak points in each skill category. Each self-assessment part is concluded by setting an achievable and concrete goal to be fulfilled during the term. The final part in each column represents evidence of the goal fulfilment to be presented during the final self-assessment and assessment session.

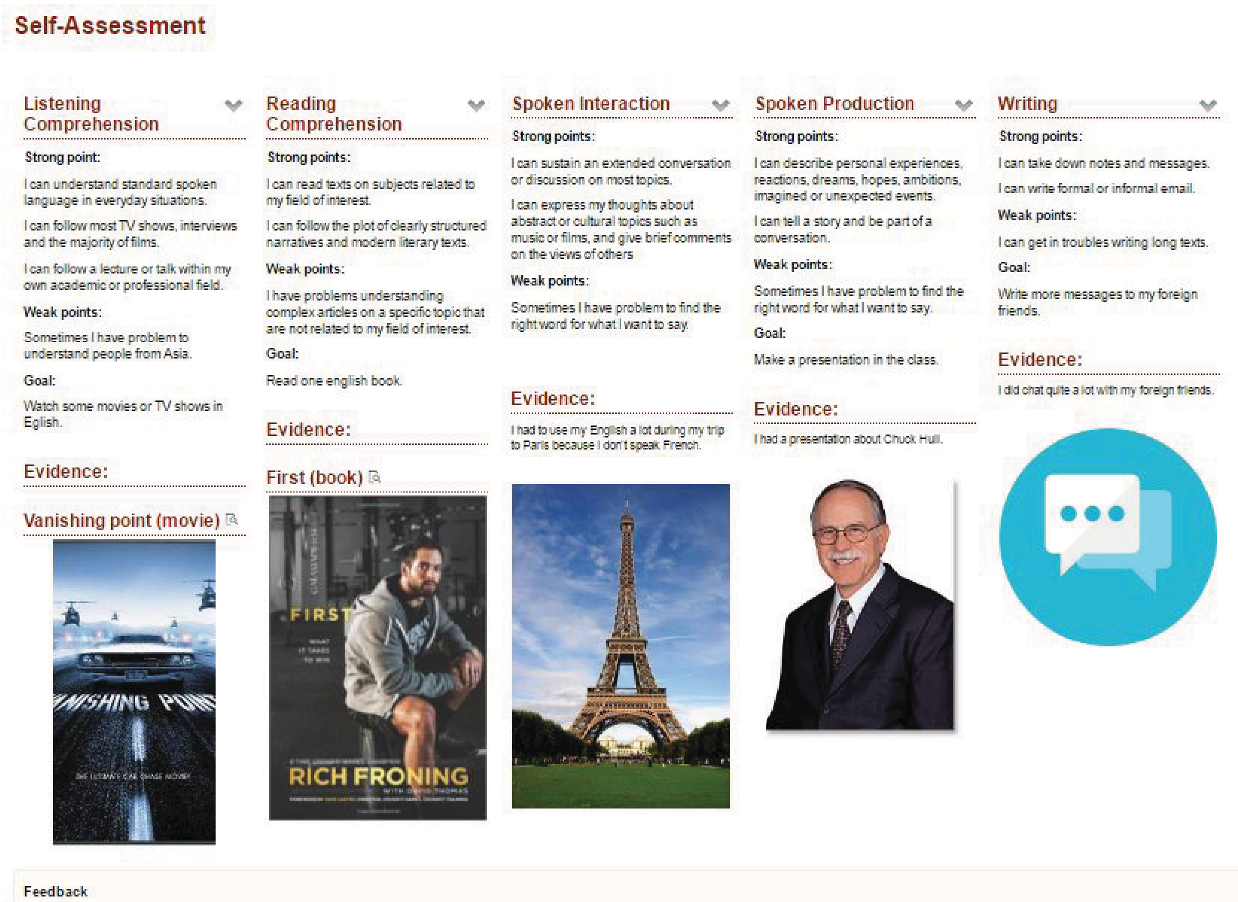


**Figure 2:** A Sample of Self-assessment and Evidence Page in Mahara ePortfolio

In the Table 4 there are selected examples of objectives and evidence demonstrating fulfilment or lack of fulfilment of the goals. Some students openly admitted the situation when they had not achieved expected results.

**Table 4:** From Objectives to Evidence

| Examples of objectives and evidence provided by students (unedited) | |
|---|---|
| **A Goal** | **Evidence** |
| *Every week I will read a short story, maybe I will try read some English book and I will search unknown words.* | *I read two english books last half year. I have read a short stories and articles from mobile phone application (English listening, speaking and reading)* |
| *I will read one english article per week.* | *In this point, I did not fill the objectives. I read only three english articles per semestr.* |

The final self-assessment and assessment process is framed by two forms adapted from The Hong Kong Polytechnic University, Cheng et. al. (2013). The first form is to be filled by the students and it summarizes what the students had learnt, their reflection on the learning process, and future plans and goals for further learning. The second form contains assessment criteria for ePortfolio Self-assessment and Evidence Page presentation. These two forms haven't yet been piloted and tested in the time of writing this article.

## 7. Conclusion

The pilot study performed at the University of Pardubice in its language courses was aimed at enhancing student autonomy and self-assessment skills through ePortfolio use. The suggested self-assessment cycle was tested in 5 courses of all tertiary levels at the university at target language levels ranging from B1+ to C1 for the model feasibility. Should we attempt to answer the questions asked in the Chapter 5, it can be concluded that the suggested model is feasible, nevertheless, the course content is demanding for both students and teachers likewise and students need to be trained to be able to assess themselves and to be capable of setting partial and achievable goals. However, when the goals are clearly set, the students are able to provide evidence of their learning. During the peer de-briefing session conducted at the end of the pilot study, in July, the participating teachers agreed on introducing new steps into the goal-setting phase tio improve quality of the outcomes. Starting at the B1 level according to CEFR, the students provided with the self-assessment grid are capable of self-assessment also in the target language. It can be concluded that within a limited period of time, growth in student autonomy was already observed and demonstrated by significant increase in number of incidents when students approached their teacher with requests for guidance and assistance with individual goal fulfilment. ePortfolio evidence pages were collected and analysed and reflected upon together with the students. Further examination aiming at obtaining answers to the question how students learn informally is necessary. The model verification process is going to be repeated several times within the English language courses and more data is necessary to be collected for further analysis.

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# Adult Learners' Motivation to Participate and Perception of Online and Blended Environments

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**Abstract:** Adult learners are an important segment of learners in online or blended learning (OBL) environments. But at the same time, this group is very heterogeneous with regard to (1) the digital skills which are diverse due to different ages or previous educational opportunities and can lead to different perceptions of working in OBL environments, and (2) the motives to enroll and persist in adult education which can be influenced by previous work and life experiences. Therefore, the present study aims to identify the learner diversity by applying the self-determination theory (SDT) of Deci and Ryan (2000) in order to explore their motives to participate in adult education. Next, this study also examined the perceptions of learners to learn in OBL environments. Qualitative content analysis was conducted on nine semi-structured interviews. The participants were adult learners enrolled in an OBL program in an adult education center in Flanders, Belgium. The adult learners indicate that the face-to-face moments are highly valued because they can learn more and better this way. However, sometimes they prefer distance moments since the content can sometimes be learned independently. Furthermore, the participants agreed on the practical benefits of OBL and the difficulty of working in groups, and provided tips to be successful in OBL environments. Regarding the motives to enroll and persist in adult education, the adult learners generally participate to be able to continue their current job, to have an alternative job possibility, or because they want a new job. The current study informs institutions and teachers about the motives of adults to participate in adult education and their experienced benefits or challenges in OBL. This is relevant since it gives an indication of components to be attentive to or to work on in online and blended adult education, specifically when trying to meet the needs of the adult learners.

**Keywords:** Adult education, motivation, online and blended learning, self-determination theory, perceptions

## 1. Introduction

Originally, adult learners (AL) have been the main target group in online and blended education (Stavredes 2011). The flexibility and convenience of OBL makes education more accessible for these non-traditional learners. However, younger, more dynamic learners, who are more responsive to rapid technological innovations are increasingly using OBL, which brings changes in the online learning population (Dabbagh 2007). Furthermore, due to family and work related responsibilities (Noel-Levitz 2014), online or blended AL have different previous work, life and educational experiences. This makes them a heterogeneous group of learners with a multiplicity of motivations, learning styles and generational differences, even within the same class. The OBL environment aims to be a flexible environment to meet the needs of this heterogeneousness. While teachers try to adjust their pedagogy and the OBL environment to meet the needs of the individual learners, they still lack knowledge about their diverse learners. A first step is to know why the AL participate in education and what they like or dislike about the OBL environment. Seeking to address this problem, the current study aims at exploring the perceptions that adult learners hold towards the OBL environment and their motives to participate in adult education.

### 1.1 Perceptions of online and blended learning

Perceptions of OBL environments, in which courses are delivered purely online or in combination with face-to-face interventions (Boelens, Van Laer, De Wever & Elen, 2015), can be expressed as preferences, difficulties or advantages. People can have different preferences and experiences because of their personal diversity. For example, their age or previous educational possibilities can create different levels of technology skills (Stavredes 2011). This can cause some learners to prefer other learning methods as they perceive them more effective (Fryer, Bovee & Nakao 2014). Furthermore, learners can experience difficulties or advantages during their learning process. Important advantages of OBL for AL with work or family responsibilities is the flexibility in time, place and pace of learning, which gives them more control on working individually (Noel-Levitz 2014; Styer 2009). According to their perceptions of OBL, learners will indicate needs to be successful in this specific environment. Dabbagh (2007) states that a successful online learner should have (1) online communication and collaborative skills, (2) a strong academic self-concept, (3) appreciation for the learning opportunities afforded by technology and, (4) self-directed learning skills.

### 1.2 Adults' motivation to participate in adult education

A frequently used motivation theory is the self-determination theory (SDT) of Deci and Ryan (2000). This theory questions why people initiate and persist in a certain behavior. According to the SDT, people can have a sense of autonomous or controlled motivation. When they are autonomously motivated, people act with a full sense of volition and choice. This is also called 'self-determined behavior'. On the other side, when people behave because they feel pressured, their motivation is controlled or non-self-determined. Next to this, people can also lack the intention to behave in a certain way which is called amotivation (Deci & Ryan 2000). In this study, 'behavior' is seen as participation in an adult education program. It entails both the enrollment and persistence in that program. While it is stated that online AL are autonomously motivated (Styer 2009), it is possible for people to be motivated by different kinds of motivations at once (Boiché & Stephan, 2014).

### 1.3 Present research

The perceptions of the OBL environment and the motivation of learners to participate in adult education are linked to each other. If learners perceive the OBL environment to be positive and valuable, they will be more motivated to persist (Fryer, Bovee & Nakao 2014). Since motivated students seem to perform better, it is useful for teachers to prepare and use their OBL courses in a way which support learner motivation. This study aims to meet the need to understand the AL perceptions of OBL environments and their motivation to participate. To achieve this aim, following research questions are explored:

1. How do adult learners perceive online or blended learning environments?
    a. Which positive aspects do they perceive?
    b. Which negative aspects do they perceive?
    c. Which 'needs' do they ascribe to successful online learners?
2. What motivations do the adult learners attribute to their participation in a program in adult education?
    a. Which autonomous motives do they have?
    b. Which controlled motives do they have?

## 2. Method

### 2.1 Sample

The sample of this study exists of nine AL who are enrolled in an online or blended course of the teacher training program in an adult education center in Flanders, Belgium. They were contacted through a previous conducted survey in OBL classes at the end of a school year in which they indicated that they were willing to participate in further research. The interviews took place at the beginning of the next school year which gave certainty that the participants in the current study have experience with OBL. The participants comprise a wide range of ages (from 23 to 53 years old) and have different educational backgrounds (from no degree to a master diploma). A short summary of participants' biographies is presented in Table 1.

**Table 1:** Sample overview: marital status, employment status and educational degree

| |
|---|
| Joren (25) lives with his parents, has a higher secondary degree and has been working for 1 year as a carpenter before enrolling in adult education. He still works as a carpenter while studying. |
| Achilles (27) lives with his girlfriend and has a master in graphic design. He is self-employed and also works as a teacher in adult education. He has been working for 3 years before enrolling in adult education. |
| Brahim (40) lives with his girlfriend and son. He always worked as a welder but because of health problems, he became a teacher in part-time secondary education. |
| Claudia (23) works a few hours a week in a pharmacy while still doing a master. She lives with her parents. |
| Amelie (29) has a master's degree and has been working for 4 years as a social worker before enrolling in adult education. She recently cohabits with strangers. |
| Philip (46) has a master's degree in communication sciences and is unemployed. He has a wife and three kids. |
| Myriam (32) lives with her son and boyfriend. She has a master's degree and has been working as a teacher both in Belgium as abroad. |
| Charlotte (24) is doing a PhD and lives together with her boyfriend. |
| Gustavo (53) lives with his two kids and girlfriend. He has a professional bachelor's degree and currently works as a teacher in secondary education. |

*Note*: names have been changed to provide anonymity.

### 2.2 Procedure and analysis

The researcher conducted semi-structured interviews with the participants. There was a broad guideline and the interviews took on average 60 minutes. The interviews covered participants' personal background, motives to enroll in adult education and their perceptions of learning in an OBL environment. Before interviewing, the participants were informed about the goals and the processing of their data. They all signed an informed consent. The interviews were digitally recorded, transcribed and anonymized. The analysis was conducted with Nvivo10. To display the adults' (1) motives to participate in education and (2) their perceptions of OBL, qualitative content analysis (Mayring 2000) was used. Regarding the analysis of motivation, the researchers used pre-determined deductive categories. This means that a priori existing categories identified from the SDT (Deci & Ryan 2000) were used. The categories were: autonomous motivation, controlled motivation and amotivation. Additionally, these categories were further differentiated in inductively derived smaller categories. This means that we constructed smaller categories based on the inductive codes used during the analysis of the data. This is done to enrich the deductive derived categories. For the analysis of the perceptions of OBL, we inductively identified three main categories from the data. These three main categories were then further specified into smaller categories, based on similarities or specific differences. The constructed main and smaller categories of motivation and perceptions were then used to develop an answer to the research questions.

## 3. Results

### 3.1 Perceptions of OBL

Most participants did not have a choice to follow their course in an OBL or non-OBL environment. Joren stated that he was not aware of being enrolled in OBL until the course started. Also Amelie mentioned that "it did not feel like blended learning". However, they all have experiences with OBL and could easily point out some positive and negative aspects. Table 3 gives an overview on the final set of categories on the perceptions of OBL. The perceptions were divided into three inductively derived categories, namely 'positive aspects', 'negative aspects' and 'needs'. Each category was further divided into different smaller categories to be able to give more detailed information.

**Table 3:** Categories on perceptions of OBL

| Inductively derived categories | Smaller inductively derived categories |
|---|---|
| Positive aspects | Freedom |
| | Face-to-face moments |
| | New skills |
| Negative aspects | Interaction |
| | Organization distance moments |
| | Technology |
| Necessities | Self-discipline |
| | Skills |
| | Personality traits |
| | Infrastructure |

Overall, there was controversy about the ability to combine OBL with other responsibilities. While some participants stated that "it was not hard to combine with the personal life", others were disappointed and indicated that OBL was "totally not combinable". Two of them complained that their family situation suffers from their participation. These learners also indicated that they will spend more time to the program than the institution promised. "It is demotivating", said Myriam.

### *3.1.1 Positive aspects*

Albeit this general negative aspect, many participants mentioned positive aspects of OBL. More specifically, the freedom they obtain is really appreciated. This sense of freedom refers to different things. In this respect Myriam said: "I can do it [learning] on my own pace, my moments", while Philip referred to the freedom of space by saying: "You are not in traffic if you have a [distance] moment". Joren talked about the freedom of time while saying:

> *Sometimes, for face-to-face moments, I had to stop working a bit earlier to get there but if it's a distance moment I could work a bit longer and start my course a bit later, I was more free.*

The participants also like the freedom because they love to work independently. Furthermore, the participants indicated that through the freedom they obtain in OBL environments, they have learned new skills. Gustavo said: "Because you learn independently and you learn to plan things", while Joren said: "If you have a problem, you will search yourself what the problem is. You will investigate more on your own, while in a classroom, you will just ask the question and you will get an answer." Even though the participants like the autonomy they get, they also still value the face-to-face moments. This was supported by quotes like "sometimes the content is really abstract so I guess it is sometimes easier if someone can explain it", "you get a lot of life experiences from the teachers" or "questions arise in class, everyone asks questions and you learn from each other".

### *3.1.2 Negative aspects*

The participants indicated that the interaction during face-to-face moments is appreciated, albeit that they sometimes perceived it as waste of time. An example is that they viewed theory as something they can learn by themselves, hence making it unnecessary to organize face-to-face moments to cover the theory. Regarding the distance moments, the participants also indicated some concerns. The distance can act as a threshold to participate in online interaction and one participant reported on a forum that has never been used. The quote from Myriam illustrates this threshold:

> *I then think to myself: have I sent this e-mail only to the teacher or can everyone see this? Is this a relevant question or would I even ask it in the first place? You then think it's maybe a silly question and then you don't ask it and you stay bothered with the question.*

Another negative aspect is the organization of the distance moments. In line with their appreciation for face-to-face moments, the AL sometimes argued that there are too much distance moments. As Philip explained:

> *Fifty percent distance moments, that was a lot […] we had to learn that by ourselves and it had been chasing us […] We had the feeling we missed something because we did not discuss it in class. […] a few teaching methods [the content they had to learn in the distance moment] were not clear, we understood it differently.*

Next to this, the link between the distance and the face-to-face moment was not always clear. Achilles called for more relevant tasks in distance moments. Furthermore, due to the distance moments the participants complained about the difficult organization of group work. Achilles even said: "Group work like that should be avoided in a blended learning trajectory". The last negative aspect, which is only mentioned by two learners, is the technology. They mentioned that technology is not infallible and gave as a limitation that when they are evaluated on their progress in learning paths, it was possible to cheat.

#### *3.1.3 Necessities*

Finally, based on their experiences with OBL, learners also provided some necessities that online or blended learners should possess to be successful. Firstly, it is important to have the right infrastructure. A computer with internet connection is required. Secondly, as Philip mentioned: "The fact that you get autonomy means that you have to possess some kind of self-discipline". Every participant talked about the need of having perseverance and not procrastinate tasks. They need motivation to work on their tasks, even if there is no teacher to encourage them at the moment. Joren illustrated this by saying: "They should not procrastinate their distance education". Thirdly, multiple skills were mentioned by the participants. Computer skills were mostly mentioned, next to organization and communication skills and "being able to plan things". To conclude, there are a few personality traits which were mentioned less, but which are not less important. The participants indicated the need to be curious to search for information by yourself and to have self-confidence. In line with this, Philip said: "[Be] self-assertive in case you have something on your mind. Throw it on the forum, don't swallow it".

### 3.2 Motivation to participate in adult education

The importance of motivation is strongly indicated in the interviews, as stated by one of the interviewees: "you need to be motivated otherwise I don't think you persist that long". The overall results not only confirm the presence of the three motivations – autonomous, controlled and amotivation – of the SDT theory (Deci & Ryan 2000), but also provide more detailed information into the diversity of motives within each of these motivations, as Achilles stated: "there is always a reason to follow a course". Table 2 gives an overview on the final set of the aforementioned deductively derived categories and inductively derived categories on the motivation to participate in adult education.

**Table 2:** Categories and codes of motivation to participate and persist in adult education

| Deductively derived category | Inductively derived category | Description |
|---|---|---|
| Autonomous motivation | Knowledge increase | Participating or persisting because of a personal desire to learn new knowledge. |
| | Future possibilities | Participating and persisting because of a personal desire for future possibilities that arise with the degree. |
| | Interest and pleasure | Participating and persisting because of personal interest and pleasure to follow a program. |
| Controlled motivation | Psychological punishments / rewards | Participating and persisting to avoid external psychological punishments like shame or to attain external psychological rewards like pride. |
| | Social support / persuasion / pressure | Participating and persisting because others encourage, persuade or force you. |
| | Job consequences | Participating and persisting to avoid external punishments with regard to the job like dismissal or to attain external rewards like job security. |
| | Personal life consequences | Participating and persisting to attain external rewards for the personal life like a more free time. |
| Amotivation | Content | Doubts to participate or persist that arise because of the content of the program. |
| | Workload | Doubts to participate or persist that arise because of the amount of work in the program. |
| | Social influences | Doubts to participate and persist that arise because of others. |

#### *3.2.1 Autonomous motivation*

With regard to autonomous motivation, results show that the majority of the participants indicated that they participate in adult education because of the increase in knowledge it offers. They stated that "it is useful because I keep learning and studying will not become strange to me in this way", "I always like to learn new things" or "I can enrich my knowledge". Another frequently mentioned aspect of autonomous motivation is the future possibilities. The participants see their participation as a valuable opportunity to create future life prospects. An example is to obtain a job that they will like more and make them feel better than their current situation. The following quote from Philip elaborates on this: "At a certain point, I made the switch, I want to do something entirely different." However, these autonomous motives are means to acquire more external goals. For example, when asking about their interest and pleasure in participating in adult education, the participants stated that the course was interesting because "I'm interested in the job" or like Brahim responded: "This [participating in adult education] is really for my job and not for fun, believe me". They do not think the course is fun but follow it as a means to achieve more external things.

### *3.2.2 Controlled motivation*

Following a course to achieve an external stated goal can be seen as the controlled motivation. Firstly, the job and personal life consequences are the most mentioned motive to participate and persist. Three participants are performing the job already but need the degree to be able to continue. So their participation in adult education is "useful, for job security". Furthermore, some participants want to obtain the job later on. To illustrate this, Claudia for instance stated that:

> *It's the first thing they ask for and look for, the thing on which they select you, the degree. So that's why the degree is useful if you want the job later on.*

Others, like Joren, see the degree as an alternative to their current job. He said: "You have an extra possibility for a job. You can perform another job if you want." Furthermore, the wage and the free time that comes with this possible new job or higher degree are also mentioned a few times. Philip mentioned it very clearly, stating:

> *Yes, in first place the wage. You don't get payed badly in education, that is a nice bonus with regard to your retirement.*

With the earned degree, Amelie stated that she can perform a job that she likes "because of the vacations". Two female and one male participant mentioned that it would be great to perform the job they are currently learning for because it would be convenient in time if they would have children. Secondly, all participants expressed that psychological punishments and rewards play some kind of role in their persistence and participation. In this regard, Myriam said: "If I will finish the program, I will be proud because I can say to others: look I'm doing it". Furthermore, most of the participants stated that they would feel some kind of guilt or shame if they would not succeed in their program. Thirdly, none of the participants was pressured by others but the recommendations they received from family, friends and employers, sometimes pursued them to enroll. The following quote from Amelie illustrates this:

> *[After a job application] I had received a phone call from the principal to say: We did not select you, […] but if I can give you a hint: obtain a teachers' degree.*

Also Joren was supported by family and friends. He indicated that "they all said, if I wanted to do that, I should certainly do it". Furthermore, social support also helps to persist, as Philip mentioned: "You get feedback like: It's going to work out for you, you are able to do that". Myriam also referred to similar feedback and expressed that it is "useful and motivating" receiving it.

### *3.2.3 Amotivation*

The participants in this study showed that they have specific motives to participate in the program. However, most of them indicated that they do have some doubts during their program. Myriam even stated that she "constantly has doubts to persist". She thinks it is useless because she already has a teachers' degree but from another country, and it is invalid in Belgium.

Other answers to the question if a participant ever had doubts to persist refer to the workload, for example: "yes, if you are working late in the night, then you think: what am I getting myself into?" or to the content of the course, for example: "I have been doubting during my education to drop out because I really think it is a boring program". Another reason to doubt to participate are social influences, as Joren stated:

> *Yes [I have doubted to participate] because, normally I would start with that education the moment I graduated from high school but I haven't done that because when I went to my solicitation interview, my boss had told me: if you think about enrolling for an education and just work here for a couple of years, I rather want you to find another job. So, then I doubted a lot to enroll and I waited for a year but I did it anyway.*

## 4. Discussion

This study aimed at providing an insight into the perceptions of AL of the OBL environment and their motives to participate in adult education in general. In contrast to the results of Fryer, Bovee and Nakao (2014), findings from this study show that the learners do value their learning method. The freedom they get in terms of time, place and pace flexibility is highly appreciated, which motivates them to enroll and persist in online courses (Styer 2009). Additionally, the participants contradict themselves by stating that too much freedom in terms of distance moments is not desirable. Face-to-face moments are still valued (López-Pérez, Pérez-López & Rodríguez-Ariza 2011). This indicates that the organization of blended learning should consider a good balance between face-to-face and distance moments. Furthermore, a negative aspect mentioned by the participants was that the interaction is very difficult in distance moments. It creates thresholds to ask questions online and it complicates the group work. Synchronous online activities can be a demotivator for online AL because they feel a kind of uncertainty to communicate online (Styer 2009). Participants in this study also advocate – like Styer (2009) - for less team activities or to make them optional because it decreases their perception of freedom and with this their motivation.

The needed skills and traits that the participants describe, are aligned with the required skills proposed by Dabbagh (2007). One participant mentions the communication skills but other participants complain about the lack of interaction in OBL, which indirectly stresses the importance of good communication (Styer 2009). Next to that, the participants indicate the need for self-discipline and other self-behaviors like self-determination and self-regulation (Dabbagh 2007). Because OBL environments provide a lot of autonomy, learners suggest that good time and organization skills are needed.

The second part of the study explored the motives of AL to participate in adult education. Findings clearly show that people can have multiple motives to do something (Boiché & Stephan 2014), in this case to participate and persist in adult education. The main motives of the participants in this study are linked to controlled motivation. This contradicts with some authors who state that AL are mostly autonomous or intrinsically motivated (e.g. Merriam & Caffarella 1999). An explanation for this can refer to the type of course. The program that the participants are following – teacher training program - is a not a program that learners do for fun. It is a program that aims to prepare for future job opportunities. Furthermore, this study identified some similarities with the report of Noel-Levitz (2014), namely: that one of the motives to participate is because of future employment possibilities and recommendations from employers.

### 4.1 Limitations and future research

A first limitation is the small sample size. Hereby, it is not possible to generalize the findings from this study. The study also only focusses on the teacher education program, so we have to bear in mind that insights, results and thoughts can be different in other programs. Further research should focus on more AL, preferably from different programs in different levels like for example secondary adult education and higher vocational adult education. Furthermore, the context should be taken into account. This is due to the fact that OBL can take many forms with regard to the amount of distance versus face-to-face moments or the kind of activities performed during those moments. Another limitation is the cross-sectional design of this study. We only interviewed the learners one time but perceptions of OBL can change due to more experiences so multiple data collection moments is desirable. Also, some learners have already had more courses in OBL environments than others. Future research should therefore take into account the (amount) of experiences of the learners as a control variable.

## 5. Conclusion

This study contributes to the scientific research concerning adults' learning motivation to engage in adult education. Moreover, it indicates the preferences, advantages and challenges that learners experience within their OBL environment. These preferences, advantages and challenges function as motivators for the learners and can be used as indicators for the educational practice to adjust their pedagogy and OBL environment. For example, learners experience that OBL is not easily combinable with other responsibilities and time-investment to get the degree is a lot higher than expected, which demotivates them. Institutions can anticipate on this by being more realistic when informing the learners about the program. They could perform intake conversations before enrollment to help estimating if the combination would be easy and which difficulties AL could encounter. This will prepare learners for possible barriers and prevent them from being demotivated.

Teachers and institutions can benefit from this study by anticipating the challenges and advantages indicated by the learners. If challenges are not tackled well by adult educators, it may lead to demotivation and drop out of adult learners. The advantages and preferences of learners may inform the institutions on the important components of online and blended education, which can inform the development of OBL programs to meet the needs and desires of AL. This can be helpful to reduce dropout and increase quality of the OBL environment.

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# Acceptance and Use of E-learning Technologies by Saudi Secondary Teachers

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**Abstract:** As in many developing countries, the Saudi government is seeking to introduce modern technology into its educational system. The Ministry of Education has provided computer labs and the National Education Portal, a digital resource available to all schools. However, as in other countries, digital technologies are not fully accepted and used in Saudi secondary schools (Lim and Khine, 2006). The Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al, 2003) has been widely used in the field of Information Systems to explain technology acceptance and use. A review of the literature suggests that a number of changes to the model would better fit developing countries. A proposed revised model was designed for the Saudi secondary context to support fuller analysis of the acceptance and use of new educational technologies by teachers, and of the influence of their perceptions and practical and affective experiences. In taking account of Saudi educational and cultural factors, the research explores this knowledge gap in the study of technology acceptance and also explores and addresses differences between teachers' stated intention to use these technologies and their actual use in practice. The paper reports on research design for an online survey and interviews to be conducted among teachers in the Jazan area of Saudi Arabia in a study, which will use mixed methods (Creswell, 2014) to investigate digital learning technology acceptance in secondary schools in a regional Saudi context. The investigative questionnaire was designed to produce both quantitative and qualitative data as a basis for subsequent phase of the study, highlighting areas that will be further explored by interviewing teachers. The study outcomes will both illuminate regional policy issues in digital technologies and, importantly advance the debate on conceptual understanding of technology acceptance in education by refining the UTAUT model.

**Keywords:** UTAUT model, digital learning technology, e-learning, Saudi Arabia, technology acceptance, secondary teachers.

## 1. Introduction

The rapid growth of information technology and our increasing dependence on it in every area of life means that citizens must gain competence in this area if they are to fully participate in society. For this reason, the right to information and education should include effective use of information technologies (Rendulić, 2013). Saudi Arabia is one of many developing countries seeking to introduce new technologies to their education system. It is the government's view that education is an important means of empowering people, and this is seen to include skills in the use of new technologies that have revolutionized every area of life (Bhatia, 2011).Understanding the experiences of teachers and the factors that affect their beliefs about e-learning technologies can help academic managers and administrators to develop systems that will encourage and support teachers to accept these technologies and to use them effectively in their teaching. To this end, it is essential to investigate the experiences and attitudes of teachers to e-learning, and to gain a fuller understanding of the barriers to its acceptance and use (Goi and Ng, 2009).

## 2. Background

The population of Saudi Arabia is growing rapidly, and the government has agreed that a university or college education should be available to every citizen. On that basis, the Saudi government has made many efforts to improve the country's education system over the last five years by building more universities and launching improvement initiatives in schools (Alshwaier et al, 2012). To meet Saudi Arabia's social and economic needs in the 21st century, the Tatweer Project aims to reform the system of education and enhance the quality of learning and teaching, particularly in state schools. The fifty secondary schools that initially participated in this project were equipped with information and communication technology (Tatweer, 2010). Other initiatives include the conversion of libraries into learning centres with electronic resources (Algahtani, 2007) and provision of a national education portal (iEN) for all students, teachers and parents in Saudi Arabia. The iEN contains over 720 books and 12,000 activities so far, and there are plans to launch further services (iEN, 2016).

## 3. Technology acceptance by teachers in Saudi Arabia

Several studies have concluded that Saudi Arabia's education system lacks the infrastructure commonly available in developed countries. Even when equipment is available to teachers, there is often insufficient technical support to ensure effective use, and this is a key factor in teachers' reluctance to use e-learning (Al-

Malki and Williams, 2012; Alwani and Soomro, 2010). However, even where resources are available, there is evidence of other barriers to the acceptance and use of digital learning technologies (Hakami, 2013).

In general, teachers' lack of skills in the use of digital learning technologies is largely the result of inadequate training. Major obstacles to teachers' attendance to in-service training programmes include time constraints and the ineffectiveness of courses, as well as cultural obstacles that prevent women from attending external training. To be effective, training needs to reflect teachers' pedagogic needs, also to offer a hands-on approach to learning new skills (Al Mulhim, 2013; Alotaibi, 2011; Alkanani, 2012).

Many Saudi teachers acquire their knowledge, skills and perceptions of learning technologies through their own educational experience, indicating that their experience of being taught through such technologies is a factor in their acceptance of e-learning. There is evidence that many teachers felt that this training was inadequate, and they had to seek help from colleagues or learn through trial and error. This situation is further complicated by the fact that some teachers have no Internet access at home. Some studies have also indicated that education policy has a part to play, especially in terms of how the Ministry of Education funds and implements digital learning technologies in Secondary schools, and how policy determines training and support for teachers in using these learning resources (Alwani and Soomro, 2010; Alsahali, 2012).

## 4. The UTAUT model

Attempts to explain technology acceptance and use have generated a great diversity of competing theories and models. To resolve this, Venkatesh et al (2003) proposed a combined model drawing on eight existing theories. Their Unified Theory of Acceptance and Use of Technology (UTAUT) proposes four factors—facilitating conditions, social influence, effort expectancy and performance expectancy—as direct determinants of behavioural intention and, ultimately, behaviour. As seen in Figure 1, these elements are influenced by age, gender, voluntariness and experiences of use (Williams et al, 2015).

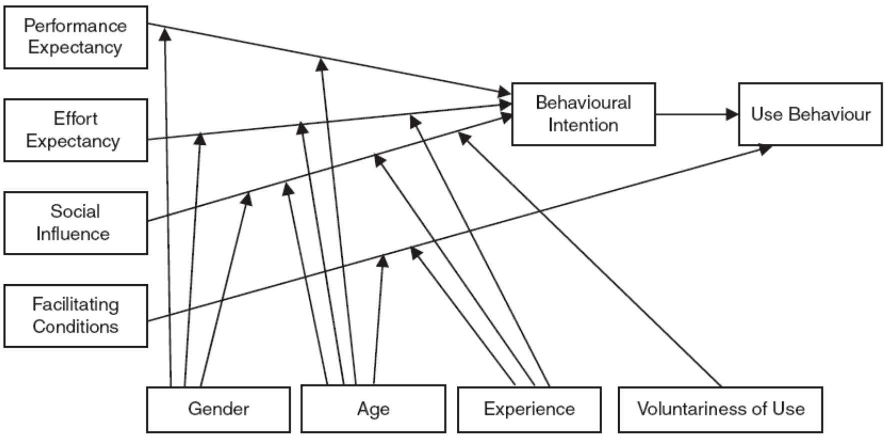


**Figure 1:** Unified theory of acceptance and use of technology (Venkatesh et al., 2003, p.447).

It should be noted that while describing the UTAUT as a "substantial improvement over any of the original 8 models and their extensions", Venkatesh et al (2003 p.467) believed that the model had certain limitations. The present study is informed by their view that factors such as "computer literacy and social or cultural background, among others" require further research (2003, p.469). The UTAUT model has rarely been used to investigate technology acceptance in the field of e-learning in developing countries, and especially the Arab countries; most such studies have been conducted in the USA and Europe (Fusilier and Durlabhji, 2005), and Venkatesh and Zhang (2010) identified a need to extend this line of research to other countries. In a meta-analysis of 42 independent papers on e-learning technology acceptance, Šumak et al (2011) noted only a "small presence of studies that have used UTAUT as a ground theory; therefore, future research needs to include studies that will evaluate this state-of-the art theory in the field of e-learning acceptance" (p.2076). They also identified a need for further research on the moderating effect on technology acceptance of factors such as cultural type. In a more recent meta-analysis of 174 technology acceptance studies using UTAUT, not a single paper was from an Arabic country or by an author with an Arabic background, although samples from Saudi Arabia were used in five of those studies (Williams et al, 2014).

Previous research points to a number of promising directions for future work, notably further refinement of the UTAUT model for application to specific educational and cultural contexts, and to take account of the practical and affective experiences of teachers. Technology acceptance has yet to be explored within the specific context of Secondary education in Saudi Arabia, and the gap between teachers' stated intentions to use these technologies and their actual use of them remains to be addressed. Accordingly, the present study tests the UTAUT model in a Saudi context, with particular reference to Secondary teachers and whether the framework's constructs explain teachers' acceptance and use of digital learning technologies. In addition, the study will analyse the teachers' current experiences and attitudes to using these technologies in their teaching practice, as well as identifying factors that prevent or hinder use of these technologies. The study also seeks to understand the relationship between education policy and the use of technology in the school environment. The findings will be used to construct a revised UTAUT model of greater relevance to the Saudi Secondary context.

## 5. Proposed revision of the UTAUT model

Based on a review of the literature and preliminary explorations of the field through informal interviews with secondary teachers in Saudi Arabia, a revised model of the UTAUT is proposed for the purposes of this study. Each of the additional constructs will be defined and accompanied by a rationale for its inclusion.

The following constructs were defined as in the original model (Venkatesh et al, 2003).

- **Performance Expectancy (PE)**: "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (ibid. p. 447). Many authors (e.g. Venkatesh et al, 2012; Alotaibi and Wald, 2014; San Martin and Herrero, 2012) have demonstrated that the relationship between PE and intention to use the technology or the system is almost always positive.
- **Effort Expectancy (EE)**: "the degree of ease associated with the use of the system" (ibid. p. 450)..Users may reject an e-learning system if they do not experience it as easy to use.(Khechine et al, 2014).
- **Social influence (SI):** "the degree to which an individual perceives that important others believe he or she should use the new system" (ibid. p. 451). In the context of education, social influence has a proven effect on the behavioural intention of teachers to utilize e-learning technologies, and this is considered an influential predictor for the usage of e-learning systems (Adegbite and Downe, 2005).
- **Facilitating conditions (FC)**: "the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system" (ibid. p. 453). In the context of Secondary education, FCs include the availability of additional resources such as online help; relevant training; adequate software, hardware and internet infrastructure and in-house technical aid. Teachers' acceptance of different technologies confirms the influence of FC on perceived ease of use and adoption of the technology by potential users (Fathema et al, 2015).
- **Behavioural Intention (BI) and Use Behaviour (UB):** Behavioural intention has been defined as "the person's subjective probability that he or she will perform the behaviour in question" (Davis 1989, p. 320), and is considered the most significant determinant of individual behaviours. The original UTAUT model includes only those facilitating conditions that directly affect actual use and does not explain the factors determining the relationship between intention to use technologies and actual use (Moghavvemi et al, 2013). To better understand this relationship, the present study will explore the impact of teacher attitudes and educational experience, as well as behavioural intention, on use behaviour.

These constructs which remain from the original model inform the following research questions:

- To what extent do performance expectancy, effort expectancy and social influence impact on behavioural intention to accept and use digital learning technologies among Saudi Secondary teachers?
- To what extent do facilitating conditions impact on use of digital learning technologies by Saudi secondary teachers?
- To what extent does behavioural intention impact on use of digital learning technologies by Saudi secondary teachers?

Further research questions are generated by the additional factors and these are shown below, after a description of each of these factors.

## 6. Suggested elements for the proposed revised UTAUT that are appropriate for Saudi society

It is proposed to add a number of elements to the UTAUT model, as the literature, preliminary informal interviews with Saudi teachers and the researcher's own experience indicate their relevance to the Saudi context. As well as addressing the research questions, this revised model will enable a fuller ongoing analysis of the acceptance and use of new educational technologies by Saudi Secondary teachers. A subsidiary research question is asked about each of these additional constructs.

### 6.1 Education policy

Effective implementation of e-learning depends in part on facilitating conditions, encompassing important issues such as fair-use, ethics, sensitive data privacy, electronic communications etiquette, encryption and security, access for persons with disabilities, management of passwords and access to the Internet and intranets (Hadad, 1995). However, technology acceptance also depends on training policies that meet the instructional needs of teachers and enable sharing of e-learning resources among different institutions and their integration with other available resources (Khan, 2014). Curriculum improvement and teacher training at both pre-service and in-service levels are central to government efforts to achieve policy objectives for acceptance of e-learning by addressing the needs of teachers (Hennessy et al, 2010).

Education policy must also address the teacher's role in the e-learning environment and its effective use in the teaching process. Active and student-centred learning must be promoted to develop the self-regulatory activities of importance for e-learning (Yengina et al, 2010; Bjekićet al, 2010). In addition, governments often regulate the content and quality of e-learning systems, and these regulations are of importance in specifying the responsibilities and rights of teachers (Harley and Lawrence, 2012).It has been suggested that a number of rules should be followed to ensure the acceptability of e-learning systems among teachers, including how best to present educational material online, the manner and the level of teacher resourcing, how teachers and students can communicate, management of teachers and operational flexibility (International Council for Open and Distance Education, 2013).

On that basis, the present study addresses the following aspects of education policy: teacher training in the use of digital learning technologies (pre-service and in-service); the role of teachers in encouraging students to use these technologies; and the rules and regulations governing their implementation and use.

### 6.2 Teachers' educational experience

Several studies note that how teachers are themselves taught is an important determinant of how they perceive educational technologies and integrate them into their practice (Nadelson et al, 2013; Miranda and Russell, 2011). Insufficient experience of these technologies has been identified as a major reason for teachers' negative perceptions and attitudes towards use in their teaching processes (Alexander, 2001; Jimoyiannis and Komis, 2007). Bjekić et al (2010) found that teachers acquire the requisite abilities, skills, knowledge, and motivation for professional teaching through their own experiences of being educated. It follows that if teachers have had a positive experience of educational technologies in their own education, this is likely to inform their later behaviour as teachers, including their perception and use of e-learning as part of their own pedagogy. Teachers' lack of confidence, then, may owe less to a lack of knowledge about specific technologies than to a lack of exposure to those technologies in teaching a specific subject matter, and teacher training may not be doing enough in this regard (Banas, 2010). Using a technology in everyday life may not in itself equip a teacher to use it effectively in the classroom (Dexter et al, 2006).

### 6.3 Technology confidence/anxiety

Teachers with long experience of computers have greater confidence in their ability to use these devices efficiently. Teachers' competence links directly to their confidence in utilizing technological devices in the classroom, and to the perceived competence of their students. Greater confidence depends on overcoming fear of technological devices such as computers (Buabeng-Andoh, 2012); and confidence can be enhanced through training programmes, regular use of personal computers, project partners and evaluative activities. To begin, this requires well-designed initial pedagogical and technical training, based on relevant curriculum activities that gradually build knowledge and skills related to information and communication technology. The community, students, and school must also be committed to encouraging teachers, with affirmative feedback from parents, students, school principals, and peers (Hennessey et al, 2010).

### 6.4 Teachers' attitudes to using technology

This is a vital factor for successful adoption of digital learning technologies. The literature suggests that PE and EE are the major factors affecting individuals' attitudes to use, and that these attitudes and beliefs change with experience (Jonsson, 2013). In the present context, teachers' attitudes are taken to include the element of self-efficacy—the beliefs that teachers hold about their ability to use and integrate digital learning technologies—which, according to the literature, has an impact on acceptance and use (Fathema et al, 2015; Buabeng-Andoh, 2012). Self-efficacy is closely linked to technology confidence/anxiety, which also affects acceptance and use (Hennessy et al, 2010), as does resistance to change.

These proposed constructs which are added to the original UTAUT model thus generated these research questions:

- To what extent does education policy impact on behavioural intention to accept and use digital learning technologies among Saudi Secondary teachers?
- To what extent does teacher educational experience impact on use of digital learning technologies by Saudi secondary teachers?
- To what extent does Technology Confidence/Anxiety impact on behavioural intention to accept and use digital learning technology among Saudi Secondary teachers?
- To what extent do attitudes to technology among Saudi Secondary teachers impact on their behavioural intention to accept and use digital learning technologies?

All questions are to be answered initially by a questionnaire survey (Phase One) conducted with a stratified systematic sample of Saudi secondary teachers in Jazan. This will be followed by semi-structured interviews (Phase Two) which will further clarify and explore the answers to these questions.

## Research Design

This study aims to integrate quantitative and qualitative data by means of an explanatory-sequential research design, as shown in Figure 2 below. Phase One of the research consists of an online survey with Saudi secondary teachers and Phase Two is semi-structured interviews with teachers who indicate they are willing to be interviewed. As well as exploiting the strengths of quantitative and qualitative approaches, a mixed methods design goes some way towards mitigating any study limitations (Creswell, 2015).

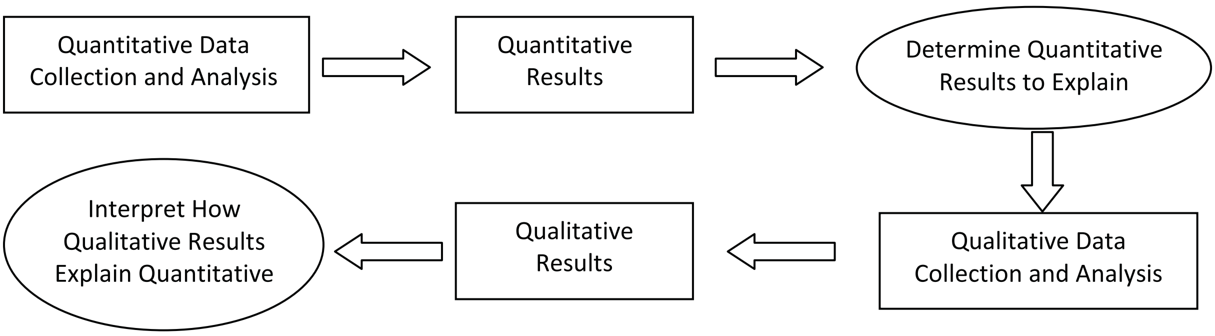


**Figure 2:** Explanatory-Sequential Design (based on Creswell, 2015)

The results from the first phase of the study will be used to structure the second phase, in terms of who should be interviewed and what questions they should be asked. In this way, the results of phase 2 will lend depth and further explanatory power to the data collected in phase 1 (Creswell, 2014). In the preliminary phase, in which general themes were identified through informal conversations with Saudi teachers, both the researcher's own experience and, crucially, what was revealed by the literature in the field informed the development of a theoretical model to enhance the exploration of digital educational technology acceptance and use (as well as any barriers) in the Saudi context.

To begin the formal phase of the research, a link to an online survey (using Qualtrics) was sent to a systematic sample of secondary teachers in Jazan. Survey questions were based on those suggested by Venkatesh (2003) and other authors. The questions (in either their original form, or adapted to fit the Saudi secondary context) were translated into Arabic. The survey was piloted with 18 Saudi Secondary teachers and scrutinised by 10 Saudi academics from various subject areas. The questionnaire was amended in line with the feedback obtained. In the final survey 347 teachers out of the 420 contacted responded. The survey results were analysed using SPSS.

Within the questionnaire, teachers could indicate whether they wanted to be interviewed. Selection of interviewees will be based on a stratified sample of participants whose responses reflect key issues identified by the survey. Following semi-structured interviews, the data will be subjected to thematic analysis.

## 7. Conclusion

To date, the study has identified factors affecting the acceptance and use of digital learning technologies in the Saudi Secondary context. The survey has highlighted areas to be explored in greater detail in the next phase of the study, when Secondary teachers from Jazan will be interviewed, enabling them to describe in their own words their experiences of using these technologies, and their perceptions and needs regarding effective use. This next phase of the study will generate new insights into how Saudi Secondary teachers view the technology in terms of its contribution to their pedagogy and the level of support and encouragement they receive. It will also shed light on teachers' perceptions of the risks involved in using these technologies; including any anxieties they may feel about their performance in front of students, as well as about the views of parents.

Given the recent emphasis in Jazan on online learning to safeguard children during conflicts with Yemen, it will be interesting to explore how teachers view this development. There are indications that workload may be a significant factor, especially as Saudi Secondary teachers work differing hours at the same pay level. Those with full timetables and a heavy workload may have insufficient time to prepare new materials that involve use of digital technologies, or they may resent having to spend more of their time acquiring new skills. The interviews will provide an opportunity for teachers to speak freely about any issues related to their experiences, hopes, fears or needs.

After Phase Two, the proposed revised UTAUT model will be reviewed in order to evaluate if it needs to be further amended to fit the Saudi secondary context.

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# Non Academic Paper

# ALiS™: An Immersive, Social Learning Environment (ISLE)

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**Abstract**: Discussions around the potential for video game and virtual world technologies to enhance learning and teaching stretch back many years, and various attempts have been made to tap into this potential (Gee, 2003). While there is huge potential for education and training to occur in multi-user virtual environments in which users describe their experiences as having 'great presence' there is a need for caution owing to the steep learning curve for students and teachers in comparison to other easier to use environments (Berge, 2008). This is being investigated as part of a Pre-Induction Gateway project at Birmingham Business School, where we have developed a globally-accessible, immersive, social and active learning platform called ALiS™ that can be deployed for a variety of educational purposes in any number of educational contexts. The broad aim of this report is to provide an update on the development of this innovative new technology and its forthcoming implementation at the University of Birmingham and beyond.

**Keywords**: social learning, active learning, technology enhanced learning, immersive, online teaching, virtual worlds

## 1. Introduction

The context for this paper is a recent University-Industry collaboration (Dowling, 2015) between the University of Birmingham and Mirrador, a UK-based SME (http://mirrador.com)[1].

In the summer of 2015, the project board for a new Pre-Induction Gateway development at Birmingham Business School recognised the potential of Mirrador's 3D multi-user virtual environment - ALiS™ - and requested that work be undertaken to customise the environment to meet the project scope.

The bespoke platform would be individually tailored to the specific needs of the user and rendered authentically to the physical environment. Students would access both generic (e.g. about life at the University) and programme-specific (e.g. learning resources) content via videos, audio narrations, posters and information kiosks in the 3D environment, plus interact synchronously with faculty and peers in ALiS™ 'chat bubbles'.

## 2. Aims

From the outset, our three core aims have been:

- To ease student transition into Higher Education by providing students who have never been on campus with the means of experiencing a true-to-life experience.
- To enhance students' experience of learning and interacting socially with fellow learners.
- To simplify teaching online by simulating real-life educational settings and workflows.

Inspired by investigations into the value of virtual worlds (the concept of virtual presence (De Lucia et al., 2009) and the thriving online communities to be found in products such as The Sims Online, Second Life and World Of Warcraft, our aim was to create an online environment that could exploit the affordances provided by existing systems such as these, while attempting to eliminate some of the key barriers that have so far restricted their uptake in education (Sanchez, 2009; Warburton, 2009).

Of the many affordances discussed in the literature related to these kinds of platforms, we focused on three that we felt were most critical to achieving our core aims, those being:

- the immersion of the learner in their learning environment;
- the variety of social and object-based interactions made possible;
- the opportunities presented by the ability to simulate 'real-life' processes and contexts.

In terms of the commonly documented barriers that are thought to have prevented more widespread usage of these environments in education, we chose to focus on addressing:

[1] The authors of this paper are employed by the University of Birmingham and Directors of Mirrador Ltd.

- the cluttered, non-intuitive user interface (UI);
- the steep learning curve experienced by many attempting to achieve mastery;
- the challenge of maintaining a consistently high quality user experience (UX) across a range of operating systems.

## 3. Exploiting affordances:

### 3.1 Immersion

To meet the first of our core aims it was decided that we would produce an extremely high quality, 3D rendered environment containing important buildings (e.g. Guild of Students, Library) and recognisable landmarks (e.g. 'Old Joe' Clock Tower) taken from the physical University of Birmingham campus. Our thinking was that the ability to explore key features of the campus in 3D prior to arriving would create a sense of comfort and familiarity on arrival, which may alleviate feelings of anxiety or isolation.

To further strengthen the sense of presence and agency within the environment (Bell, 2008; Thomas & Brown, 2009), it was decided that users should independently navigate the environment by directing an easily-controllable avatar that either 'walks' or 'teleports' to locations simply by clicking on them. The avatar itself would also be quickly and easily customisable by the user in order to allow users the freedom to express themselves, whilst also forming a sense of ownership and belonging.

### 3.2 Interaction

The ALiS™ platform takes advantage of contemporary media delivery and cloud-based networking technologies to give users access to both synchronous live-audio 'sessions' (e.g. lectures, classes, meetings) and asynchronous learning materials, that we call 'exhibits' (e.g. video, audio narration, posters, kiosks). This allows us to present information seamlessly and in a variety of ways to suit diverse learner and teacher preferences.

On top of this, users can independently generate live, text-chat 'bubbles' which provide an intuitive and authentic conversational experience by allowing people to freely 'mingle' with other active users, and to join and leave conversations whenever they choose to. It was felt that the peer and faculty interactions this empowers would further consolidate the sense of familiarity for new students, with the platform essentially allowing friendships to form prior to arrival.

### 3.3 Simulation

Real-time social interaction in ALIS™ can be further enhanced by 'proximity' to the asynchronous content mentioned above. In other words, much as one would in a real-world museum, ALiS™ users are free to explore objects, artefacts and exhibits *at the same time* as having conversations with other users that can be directly related to those objects, artefacts and exhibits.

This method of simulating 'real world' learning contexts/settings is arguably the most significant feature of the teaching toolset that is provided within the platform. Users with the 'Teach' role and associated permissions can quickly and easily open 3D representations of lecture theatres, classrooms, exhibition rooms and meeting rooms, each of which represents a synchronous online tool in its own right, and each of which functions as closely in parallel to the lived experience as is currently possible within a virtual environment.

## 4. Removing barriers

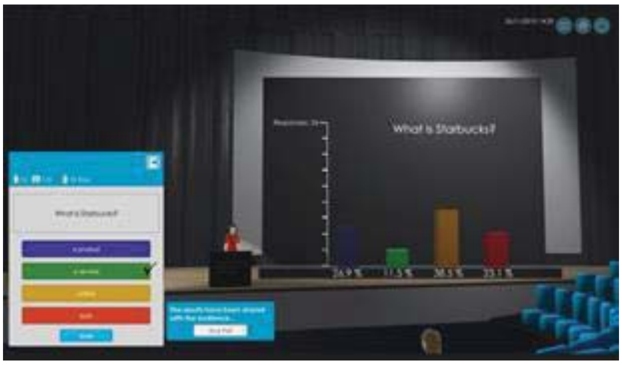
Although it is of course important to assess exactly what a technology empowers its users to do, it is arguably just as important in this context to focus on how quickly and easily it allows them to do it. Given our core aims, it became clear very early on in the project that if we hoped to produce a tool that would appeal to modern-day students and busy, multi-tasking teachers, then we would need to address and resolve commonly identified issues around usability, mastery and accessibility.

### 4.1 User interface

Due to the massive scope and extreme complexity (both geographically and functionally) of open virtual world environments, they are often cluttered and confusing. Navigating numerous functions and options, plus complicated menu systems without expert guidance is at best frustrating and time consuming, and at worst completely overwhelming. ALiS™, however, has been designed to be easy to use right from the start, irrelevant of what people are using the platform to do. By implementing an intuitive icon-based interface, the user experience is clean, simple and instantly familiar.

### 4.2 Learning curve

A significant obstacle that virtual world products such as Second Life have been as yet unable to overcome, is the steepness of the learning curve involved in achieving the level of mastery required to take advantage of the pedagogical benefits.




By narrowing the focus of the available toolset to a small number of key teaching and learning related functions, and simulating real-life settings and work flows, ALiS™ allows teachers to simply do what they already do (e.g. give a lecture, have a meeting, etc.), but with the added value of an international, online audience. An additional, but significant benefit of this method is that it essentially removes the need for staff to attend time-consuming and inconvenient training sessions before they can capitalise on the affordances of the toolset.

### 4.3 Consistency

One of the main challenges with real-time 3D rendering is to maintain a consistently high quality user experience across the range of commercially available devices. Internet connection speed, Computer Processing Unit (CPU) and Random Access Memory (RAM) requirements, screen size and platform incompatibilities (e.g. Windows and OSX) are all pivotal considerations for software development of any kind today.

In the early graphic design phases of ALiS™ development, many decisions were made based on the ethos that the platform should look great, and be as immersive and as fun to use as possible, but not to the detriment of the smoothness and seamlessness of the baseline user experience (e.g. someone on an older, low-powered laptop). The knock-on practical effect and benefit of this strict design principle is that engaging with the virtual environment has a minimal impact on CPU usage and battery life.

## 5. Next steps

In July this year, the Pre-Induction themed customisation of the ALiS™ platform will be implemented as a pilot, and offered as “added value” to all incoming Birmingham Business School students in parallel with pre-existing materials that are sent out via email and made available through the School’s iVLE. Data on this pilot will be collected and analysed, with a view to informing the more formal deployment of the system for the same purpose in September.

At Birmingham Business School, we continue to work with academics to explore pedagogical and pastoral uses of the ALiS™ platform. Two of the projects with the most traction currently are:

- Virtual Case Museum (VCaM) – Through the Alumni newsletter, University of Birmingham graduates have been invited to record a 5-10 minute 'video blog' in which they describe the organisation they work for, their role within it, and discuss challenges and dilemmas they have faced in their professional lives. These videos will be made available to all staff and students as a virtual exhibition in ALiS™. The core aim of the project is to widen and deepen students' appreciation, while they are still at university, of the richness and diversity of real-life business and organizational situations, and of the knowledge and thought that goes into confronting real-life problems. More widely though, it is seen as a genuine enhancement of the whole learning and teaching environment.

- Virtual Essay Advice Hub (VEsA) – A social hub will be created in ALiS™, surrounded by a number of 'topic rooms' containing multimedia resources that provide expert advice and suggestions for students on choosing the right topic for investigation in dissertations and extended essays.

Meanwhile, through close collaboration with the University of Birmingham (http://birmingham.ac.uk), Sheffield Hallam University (http://shu.ac.uk) and XP School (http://xpschool.org) the interface and functionality of the ALiS™ platform are being constantly refined to cater for a broader and broader range of educational clients and needs.

Mirrador plan to release a universal, subscription-based version of our virtual teaching toolset, called the 'ALiS™ Hub' (including 3D interactive lecture theatre, classroom, exhibition room, meeting room and social hub) later this year.

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# Work in Progress Papers

# Casting the 'net' in autonetnography: professional development in networked learning teaching praxis

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**Abstract:** A move towards networked learning within higher education may challenge the professional development needs of experienced face-to-face teachers learning to teach online. Analytic autonetnography as an emerging eResearch methodology is introduced as an experiential exploration of my networked learning teaching praxis (NLTP). Reflexive blog-noting, narrative visibility and dialogue with a peer-debriefer will precede theoretical analysis of peer reviewed literature to consolidate an informed interpretation of my NLTP.

**Keywords:** Autonetnography; networked learning teaching praxis; online teacher professional development; reflexivity

## 1. Introduction and background

A professional obligation to practice lifelong learning through continuous professional development in conjunction with an increasing move towards networked learning (NL) within higher education teaching practice has implications for experienced classroom teachers developing skills in networked learning teaching praxis (NLTP). NL is defined by Goodyear et al. (2004, p.1) as not only the use of technology to enable learning, but human-to-human interactions between learners as peers, "between learners and tutors; between a learning community and its learning resources". NL as an additional pedagogic approach challenges the professional learning needs of higher education teachers, who may have considerable subject experience in a face-to-face setting, yet limited (if any) (Berge, 2008) experience of teaching online (Rienties, Brouwer, and Lygo-Baker, 2013). There are a number of professional development frameworks available to support neophyte online teachers, for example, the 5-step *eModer@tion* model (Salmon, 2011); Technological Pedagogical Content Knowledge (*TPCK*) model (Mishra and Koehler, 2006); *4I Model* (Cowan, 2013), the *e-learning Ladder* (Moule, 2007) and the *6THREE Model* for enhancing academic teachers' capacities for effective online teaching and learning (Segrave, Holt, and Farmer, 2005). My research focus differs from these examples in that I intend to undertake self-exploration of my online teaching practice through the unique, critically reflective, lens of autonetnography.

## 2. Research focus

The concept of autonetnography was introduced by Kozinets and Kedzior (2009) as an extension to netnography (Kozinets, 2006) in the context of examining insider experience of participating in Second Life©. Autonetnography is defined as a research methodology that "captures and documents [online] experiences through the careful personal observation of online participation, autobiographical attention to the interrelation of various experienced 'worlds' … reflexive field-noting, self- and first-person image and other data captures, and first person narratives which make their way into the final representation" (Kozinets and Kedzior, 2009, p.8) of the researcher's autonetnographic text.

My specific interest lies in the *experiential* application of autonetnography as an emerging eResearch methodology to inform my professional learning as I develop online teaching skills in NLTP. An opportunity to examine more closely a subjective and reflexive insider-researcher perspective of being an experienced face-to-face teacher yet neophyte online teacher would respond to a gap in current eResearch knowledge.

## 3. Research question

How can analytic autonetnography be used to develop my networked learning teaching praxis?

### 3.1 Research sub-questions

- How does analytic autonetnography inform my professional development as a face-to-face teacher, learning to teach online?
- In what ways has self-examination of my development as an online teacher transformed my networked learning teaching praxis?

- What skills, resources and data collection methods informed reflexive analysis of my networked learning teaching praxis?
- In what ways might analytic autonetnography benefit other face-to-face teachers' professional development as they learn to teach online?

## 4. Study design

My interpretation of analytic auto**net**nography as methodology merges Anderson's (2006) five features of analytic auto**eth**nography with Denzin's (2014) interpretive auto**eth**nographic paradigm to include: 1) Complete member researcher status where I research my own online teaching practice; 2) Analytic reflexivity through the maintenance of a reflective blog; 3) Narrative visibility of myself as a researcher through self-reflection; 4) Dialogue with informants beyond the self (peer-debriefer, reflexive interview and student opinion); and, 5) Theoretical analysis of peer reviewed literature.

A case-study will focus on a 10-week wholly online Masters in Professional Practice module whereby I am the online teacher. Using case-study to frame my analytic autonetnography focuses on a specific 'case' to allow me as the researcher to "understand complex social phenomena" associated with NLTP in conjunction with "retain[ing] a holistic and real-world perspective" (Yin, 2014, p.4). The case-study approach will support my aim to collect detailed information about my online teaching practice in a specific case (Hammersley and Gomm, 2000) so that the learning I gain from exploration of this data will inform my future professional development in NLTP.

In keeping with the tradition of autoethnographic research, data will be collected through a combination of methods (Adams et al., 2015; Hayler, 2011; Holman-Jones, Adams, and Ellis, 2013): self-observation of my NLTP will examine the ways in which I interact with learners by observing the patterns and frequency of my interactions; researcher reflexivity, as the "capacity of the researcher to acknowledge how their own experiences and contexts (which might be fluid and changing) inform the process and outcomes of inquiry" (Etherington, 2004, p.31), is an essential component of autonetnographic methodology; I aim to demonstrate trustworthiness and validity as I share my online teaching self with the reader by integrating 'peer-debriefing' (Lietz, Langer, and Furman, 2006), a collegiate 'checking' that I am being honest with my data analysis, through interaction with a colleague via a password protected reflective blog. The purpose of sharing the reflective blog, gives the peer-debriefer an opportunity to challenge potential assumptions and question perceived judgments by responding to my blog and facilitating a recorded (to be transcribed) reflexive interview that requires the peer-debriefer to interview me. I argue that these depths of critical reflection are required for transformative learning to take place, and significant to my intention to demonstrate probity as I explore my own NLTP through the lens of analytic autonetnography.

Theoretical analysis of my data is essential to maintain the analytical focus on my autonetnography. I recognise and embrace the argument that autonetnography is a "highly self-reflective and introspective process, [and] unless there is a methodological way of keeping a distance from this process, [I could] easily fall in to self-absorption" (Chang, 2008, p.96). I limit the likelihood of self-absorption, through interpreting, analysing and comparing my findings with peer reviewed literature, using Srivastava and Hopwood's (2009, p78) reflexive analysis framework:

Q1: What are the data telling me? (Explicitly engaging with theoretical, subjective, ontological, epistemological, and field understandings);

Q2: What is it I want to know? (According to research objectives, questions, and theoretical points of interest); and,

Q3: What is the dialectical relationship between what the data are telling me and what I want to know? (Refining the focus and linking back to research questions).

## 5. Ethical considerations

Despite a focus on the self within autonetnographic research, the ethical considerations when undertaking autonetnography are extensive. Not only might the autonetnographer feel vulnerable if they discover elements of themselves that they did not know existed or may not particularly like (Holman-Jones, Adams and Ellis, 2013), but divulging personal data collected through journals, field-notes, autonetnographic interviews and conversations with others, can implicate others (Turner, 2013) in a way that they may not appreciate nor have the power to challenge. Even strangers can become connected to the self “through membership of common experiences, if not through personal contacts” (Chang, 2008, p.65). Muncey (2010, p.106) suggests that three interrelated ethical responsibilities should be considered by the autoethnographic author: “Acknowledgment of narrative privilege” whereby the author should protect those who (by the very nature of the author’s declaration of self-examination) are implicated as co-participants; “Acknowledgment of narrative media” by considering whether or not those affected by the autoethnography are able to engage with the medium in which the author’s narrative is presented (whose interests such presentations are intended to serve); and, “Acknowledgment of ethical violence” whereby the author’s “interpersonal obligations affect [their] work” with the potential of leaving those implicated within the autoethnography at risk of harm. Because I plan to do autonetnography by being the autonetnographer, the focus of my data will be my online teaching praxis. Written consent will, however, be sought from the learners on the Masters in Professional Practice module and my peer-debriefer, to share my findings and check my interpretation of those findings with them and report them anonymously.

## 6. Discussion

This research intends to bridge the theory practice-gap that remains between Kozinets and Kedzior’s (2009) claim that autonetnography as a possibility and the reality that there is no current theory upon which to practice autonetnography. This opportunity to examine more closely the subjective and reflexive insider research perspective of being an online teacher would respond to this cap in current theory at the same time as exploring the reality of undertaking autonetnography in practice.

## 7. Conclusion

This paper explains the early stages of my PhD research to explore how analytic autonetnography can be used to develop my NLTP, including the study design and considering the ethical implications on self and others, when undertaking a study with an emerging theoretical background.

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# Student Perceptions of ePortfolio as Competence Assessment During the Practical Training Period for Early Childhood and Primary School Teaching

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**Abstract:** Many teacher education institutions aim to develop and assess teacher competences during teaching practice. This study explores students' perceptions regarding the integration of electronic portfolios (ePortfolios) during teaching practice. It is a result of the pilot study of an innovation research project. The aim of this project is to determine the key aspects in the use of technologies for learning and knowledge in the development, monitoring and mentoring during the practical training period between mentor teachers of school, tutor professor and students' double university degree in early childhood education and primary education. Data was collected through Focus Group to capture deeper information that will help to know most significant ePortfolio learning experience and how to make the educational teaching practicum more meaningful. This paper discusses the findings of a pilot study that set out to explore student perceptions of ePortfolio experience on four categories: (1) planning, organizing and time managing; (2) interaction, reflection and feedback; (3) Content and collecting evidences and (4) useful and usability of ePortfolio.

**Keywords:** ePortfolio, student perspective, teacher education, higher education.

## 1. Literature review

Teachers' training is an academic training where the knowledge not only grows from the research but also from the experience. Practicum has an important role in the development of the professional competences and, hence, school becomes an interactional space between theory and the practice. Accordingly, it is a training context, which eases the implementation of the different learned resources from the learner (Alvarez, 2012; Le Boterf, 2002; Tejada & Ruiz, 2013). In this way, as Zabalza (2009 & 2011) states the practicum represents a curricular space available in order to prove the integration of the acquired competences from the students and so, these period becomes a key point for the creation of a relation between theory and practice.

In this sense, the relationship between the university and the schools is substantial. Both tutors of faculty and school have to accomplish monitoring functions for following and promoting the acquisition of the teachers competences in the early childhood and primary education (Coiduras, J., Cornadó, M.P., Fuertes, M. T. & Peire, T., 2016; Ros, Martínez, & Prats, 2015).

In reference to the monitoring, the evidences are the projections that the student selects as substantial documents in order to demonstrate de abilities, the capacities and the learned competences in this process. Therefore, the portfolio is a significant tool for realizing the evaluation of those competences. From this perspective, the portfolio use allows the possibility of publishing the evidences in a digital version and eases both the professors and students access to these diverse formats (Bairral & dos Santos, 2012; Sunstein & Lovell, 2000; Zawacki-Richter,Baecker & Hanft, 2010).

## 2. The project

The present project uses the e-portfolio as a tool to collect the evidences of the learning process for the preservice teachers. According to that, the selected methodology is Design-Based Research (DBR). It consists on a systematic study as it contemplates different phases which we are constantly working on in order to improve the chosen resource consistently. DBR normally lies in three big phases, from the most generic one to the most specific one. Those phases in our project have been structured in: (1) Needs and context analysis; (2) Design, development and formative evaluation and (3) Semi-summative evaluation. The data was collected in the second one by questionnaires and a focus group released to five students, which are the respondents of this project. Taking everything into account, we have defined two general aims and five specific ones.

The general objectives of the project are:

- GO1: Taking into account the profiles of tutors in the university and schools contexts from both the training and technological perspectives, to determine the key aspects involved in the use of KLT tools such as e-portfolios in the development, monitoring and mentoring of student practicums.
- GO2: Using the rubrics and indicators associated with teacher competences, to generate the procedures and instruments incorporated into the e-portfolio in order to collect and validate competence-based evidence.

Our specific objectives are:

- SO1: From the perspectives of tutorial activity and technology, to draw up tutor profiles by identifying the competences tutors are expected to possess.
- SO2: To design a portfolio structure that is adapted to the actions students are required to conduct on their teaching practice.
- SO3: To set the basic tasks students and tutors need to perform to be able to use the portfolio as a support tool for learning and improving tutorial activities.
- SO4: Through the use of eportfolios, to apply a set of rubrics and indicators for evaluating the competences student are expected to acquire on their teaching practice.
- SO5: From a consensus among tutors, to associate with this set of rubrics and indicators a procedure for collecting and validating evidence.

For its suitability and convenience, the method we selected for our project was Design-Based Research (DBR). DBR is a systematic process for analysing, designing, developing and evaluating an intervention as a solution to a complex problem. Specifically, we use the variant Educational Design Research (EDR) which is appropriated for educational design process (Plomp & Nieveen, 2009; van den Akker, Gravemeijer, McKenney & Nieveen, 2006).

On the other hand, this centres on complex problems arisen from real contexts promoting the interaction between researchers and participants. All of this does by means a rigorous and reflexive study that promotes the continuous improvement. Consequently, this is a process on a long-term basis that it involves so much theoretical building about the solutions of tangible problems (Salinas, 2011).
Taking into account the methodology, the project has been structured in three big phases.

- Needs and context analysis: in this phase both needs and context analysis is done, a literature one and it develops conceptually and theoretically of the study aim.
- Design, development and formative evaluation: the second phase is about prototyping with a formative evaluation. In this way, different interactions occur in order to make a continuous improvement, and so, for improving the intervention.
- Semi-sumative evaluation: this last phase allows establishing the conclusions and, for this reason, it is called semi-summative as the solution of the problem is obtained from it, or even a recommendations summary for improving similar interventions as well.

According with these our experience is situated in the second phase, so we designed a portfolio prototype. Data was collected from 40 students with a questionnaire and a focus group with 5 students.

## 3. ePortofolio Design

The results of the phase 1 enabled us to design a catalogue of evidence associated with the competences acquired on the practicum. A rubric based on size, objectives, actions and examples of evidence was designed. Hence, the catalogue has been designed by creating different structured tabs taken from the literature and the practicum report which the institution owns.

The portfolio has been designed splitting of the structure of Mahara, which is used by the University. Therefore, we start the process with the generic design to arrive at our final result that is used with the preservice teachers students. The project has arrived there by integration of the different parts of the practices report.

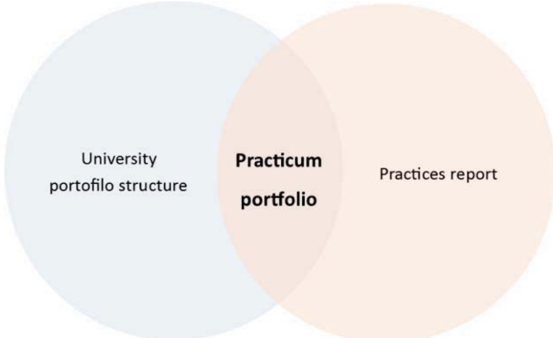


**Figure 1:** Practicum portfolio design

The rubric was validated by the project team, which included professionals from the schools participating in the project. The schools were a sample of local public (state) schools from a rural environment and state-sanctioned private schools and public (state) schools from an urban environment. The URV team was made up of academics responsible for kindergarten and primary education that coordinate student practicums in those areas, as well as two full-time researchers with methodological and technical profiles (Esteve-González, V., Sánchez-Caballé, A., Marqués, L., Holgado, J. & Cela-Ranilla, J., 2015).

From this catalogue of evidence, we designed the practicum portfolios using the Mahara tool built into the Moodle virtual learning environment (Figure 1 &2).


**Figure 2:** Design of the practicum ePortfolio.

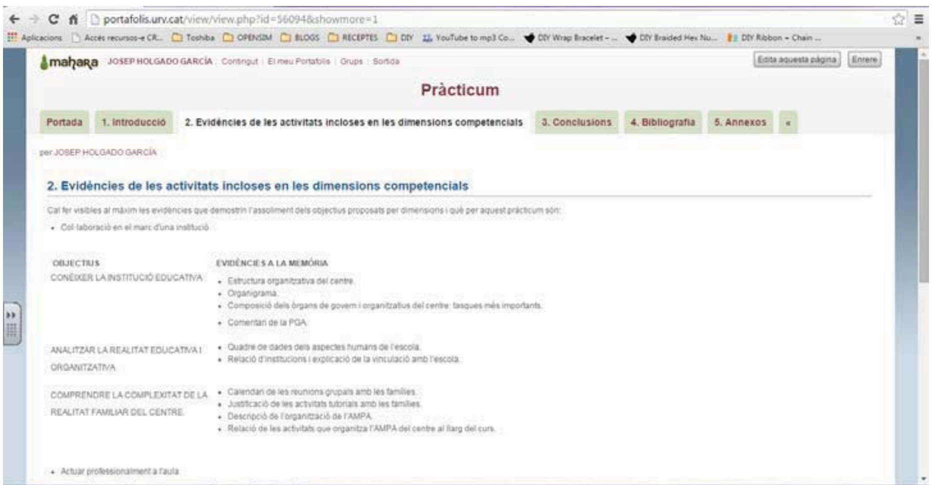


**Figure 3:** Structure of the practicum's competence-based evidence.

## 4. Results

The researchers asked the preservice teachers who used the portfolio during their practice period about the advantages and disadvantages about the usability of their portfolio template by a focus group. The results of that process are related to the second general objective and the second, fourth and fifth specific objectives. By the way, the collected information was organized by categories which are the result of the phase 1 (literature review):

1. planning, organizing and time managing

   The students believed that the portfolio helped them to organize their report better than a traditional report. They explained that the portfolio enabled them to better organise content, though there was little freedom to adapt the template. They also reported that the organisation of time depended on several factors for which the tutors and the schools were responsible.

2. interaction, reflection and feedback

   The students also expressed the opinion that their tutors, especially those in the schools, should receive more extensive training in using the portfolio and reported that they had generally not shared their portfolios with other students.

3. Content and collecting evidences

   They believe it is positive that different types of evidence can be included in the portfolio because sometimes they consider that no written explanation is necessary. As this enables more space to be available during the reflection process, they believe that the use given to the evidence included is more practical and operational. On this matter they believe that more training is needed.

4. useful and usability of ePortfolio

   With regard to the tool's usability, the students believe it needs to be more flexible when generating new structures. At the same time, however, they greatly appreciate the diversity of evidence the tool enables them to include since this makes the portfolio quick, useful and attractive to use. Finally, they also highlighted the fact that the portfolio helps them to draft their report of their student practicum.

## 5. Conclusion

The principles based on the results (regarding to the tool's usability and content) of the first iteration, that we should integrate into a future process, are:

- The template needs to be more flexible when generating new blocks in the view of the ePortfolio. This approach would facilitate the integration of evidence demanded in the practices and process feedback.
- It was appreciated the diversity of evidence the tool enables them to include since this makes the portfolio quick, useful and attractive to use.
- Must be incorporated a specific training for tutors in order to provide feedback.

## Acknowledgements

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# Comparison of Higher Education Student and Teacher Perceptions of E-learning

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**Abstract:** Currently e-learning is considered an essential part of the everyday learning processes for both teachers and students in higher education. However, the learning results of e-learning are under debate and there is a growing critique on the efficiency and actual results of e-learning. In this paper we present our on-going work for exploring higher education students' and teachers' recent perceptions of their e-learning experiences. Two surveys were conducted in order to investigate and compare the perceived advantages, challenges and needs for support among the students and teachers in higher education. The results indicate that the perceived advantages of e-learning for both teachers and students were fairly similar. Flexibility in use of time and place were found as the most important benefit of e-learning. The main challenges in e-learning for both students and teachers dealt with technical issues and teacher-student interaction. Both students and teachers also experienced problems in directing the learning situation. Based on the studies we suggest that in order to ensure high-quality learning results in e-learning, continuous and relevant training and peer support for educators and students are needed. Additionally it is important to enhance the user experience and to carefully design the content and materials of the courses. Finally, we suggest that in e-learning the interaction between teachers and peer students should be improved.

**Keywords**: e-learning, technology enhanced learning, higher education

## 1. Introduction

To date much research defines e-learning as all forms of electronically supported learning and teaching. These educational experiences where skills and knowledge are transferred occur both in and out of classroom and are supported or delivered by technology (Donnelly et al, 2012). Another term for e-learning used is Technology Enhanced Learning (TEL). These terms describe the role of technology as "socio-technical innovations that will support and enhance learning practices of both individuals and organisations" (Manouselis et al, 2011). However the term TEL has also been criticized for being adopted too easily as a useful, inoffensive and descriptive term, when in fact it is actually rather complex and includes possible problematic social, technological and educational changes (see e.g. Bayne 2014). In this paper we understand e-learning as transferring skills and knowledge between teachers and students, the questioning of the content and the creation of new knowledge by means of different technological applications.

The new technologies have expanded the possibilities in relation to where and when teaching and learning could happen. As a result, higher education teachers and staff are expected to act as designers of learning processes and environments as well as developers of collective learning experiences. However the lack of teachers' skills has been seen as a challenge (Weber 1999). In a world changing fast particularly in the fields of technology and globalization, a reform is needed in higher education (Williams, 1999).

According to studies e-learning can facilitate self-paced or instructor-led learning and with the help of media available teachers can produce rich and interactive learning experiences. E-learning is also found equally effective in knowledge transfer and acquisition compared to traditional methods. (Donnelly et al, 2012) Depending on the teaching method used, digital technologies can enhance the teacher-student dialogue and enable certain kinds of activities and feedback that traditional teaching methods lack. Additionally digital technologies have created a significant change in the quality and range of resources available to education. (Laurillard 2012)

The key question today is whether the actual learning outcomes of students have improved when learning is increasingly taking place in electronic learning environments, especially in the case where only lecture videos are being used as the main learning materials (see e.g. Koedinger et al 2015). Also the different pedagogic approaches used in e-learning activities matter. It has been noticed that minimally guided approaches used in delivering online studies might not bring about the best possible learning results (see e.g. Hase & Ellis 2002, Kirschner et al 2006 and Kirschner & van Merriënboer 2013). We need "more critical understandings of the pedagogic and societal impact of technological change" (Bayne 2014). Students may appreciate e-learning for its opportunities but some students have criticized the acquisition of conceptual and methodical knowledge. Face-to-face learning components are favored when the learning process included conceptual knowledge in the subject matter, skills in the application and use of one's knowledge in practice, knowledge and skills in scientific work routines, or in communication (Paechter & Maier, 2010). As a consequence it is important to study further the perceptions of e-learning to better understand how the students' learning achievements and experiences courses could be improved.

The main problems that plague e-learning are poorly designed packages, inadequate technology, lack of skills, need to integrate a face-to-face teaching component, the time-intensive nature of e-learning and computer anxiety. As a solution for these problems, they offer standardization, funding, integration of e-learning into the curriculum, blended teaching, user-friendly packages, access to technology, skills training, support, employers paying e-learning costs and dedicated work time for the school to deliver e-learning. (Donnelly et al 2012) Furthermore an important factor is the stimulation of learning motivation, the structure and coherence of the learning material and the course and the facilitation of collaborative learning with the help of a professional instructor. (Paechter, Maier & Macher, 2010.)

## 2. Our Research

The overarching goal for this study is contribute to the debate on how to ensure successful learning outcomes in e-learning environments. To this end, we follow a two-pronged approach: first, we investigate teachers' and students' experiences and perceptions of e-learning. Secondly we compare and contrast these understandings in hopes of determining the e-learning activities with the potential of achieving high quality learning outcomes.

This paper builds upon an earlier study on higher education teachers' perceptions on utilizing distance learning (Ålander & Karukka, 2016) and a recent survey conducted with higher education students. The survey was sent via email to teachers working in higher education at Oulu University of Applied Sciences (OUAS) (n=51). The students' questionnaire was mainly similar and it was published in the OUAS intranet (n=147).

The questions were related to learning experiences, usefulness of e-learning tools and environments (e.g. Optima, Moodle, Adobe Connect Pro and Skype), the possible challenges encountered and the form of support the teachers and students preferred.

### 2.1 Results

The results of the study for both teachers and students highlighted the importance of independence that e-learning bestows upon them in relation to time, place, flexibility and individual options. However, the flexibility is more emphasized by the students than the teachers. In accordance with the expectations mentioned by Weber (1999), e-learning is seen as flexible in that it enhances students' taking charge of their own studies. 12 % of the teachers perceived e-learning to be more capable than traditional learning to foster active learning environments. This is especially true with reference to increasing student presence, participation as well as collaborative and individual learning. However, this perception is not shared by students. When it comes to learning material provided by the teacher the students preferred traditional PowerPoint-presentations (71 %) and audio-visual materials (47 %). Also learning materials produced by other students were found useful (36 %). These materials were also the ones the teachers used the most.

The main challenges in e-learning for both groups dealt with technical issues related to non-functioning data connections and software. Another common challenge were the difficulties in interaction between teachers and students. However the problems in interaction is more emphasized by the students. Both students (44 %) and teachers (23 %) also experienced problems in steering the learning process. Other pedagogical issues included how to arrange individual tutoring suitable for different students. This result is similar to Paechter and Maier's (2010) study where face-to-face communication was favored in certain areas of educational activities. When it comes to challenges the main differences in between the teachers and students perceptions concerned the skills needed in e-learning. The teachers experienced more challenges with technological skills than the students.

For teachers the most important element regarding support for e-learning from was cooperation between teachers (e.g. sharing ideas and experiences, discussions about technological and pedagogic issues). A third of the teachers had created digital course materials together or shared their own materials with other teachers, but only a minority had experience of co-teaching, planning courses together or acting as a peer mentor. When it comes to support, students preferred group tutoring, individual guidance and peer support. The students also wanted more information about their possibilities to accomplish studies in e-learning environments.

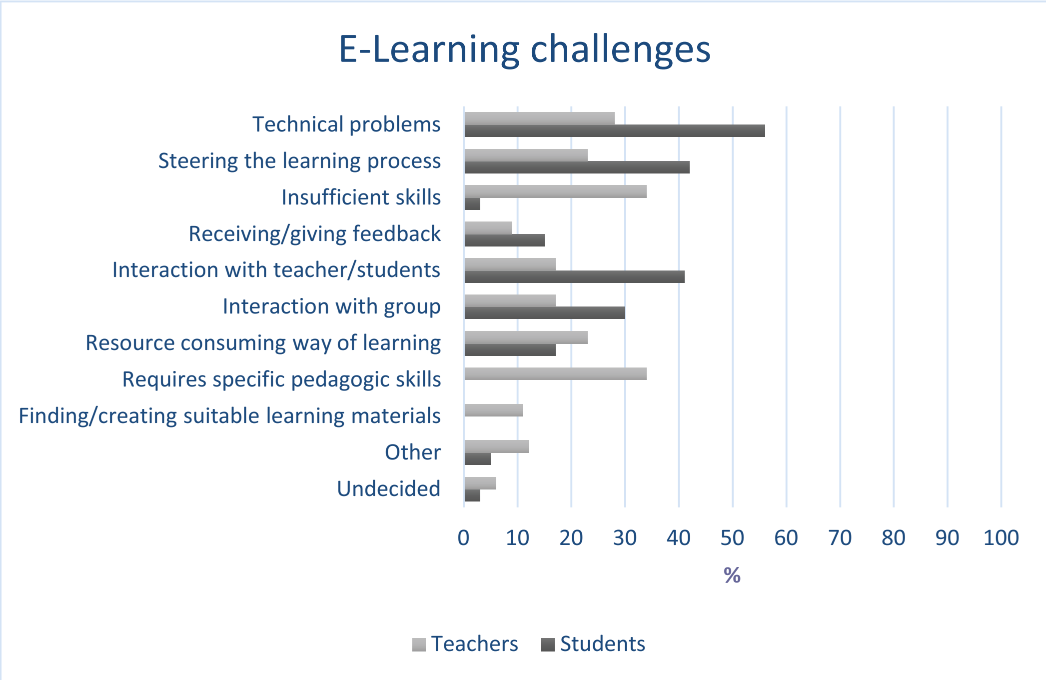


**Chart 1:** Student and teacher perceptions of e-learning challenges

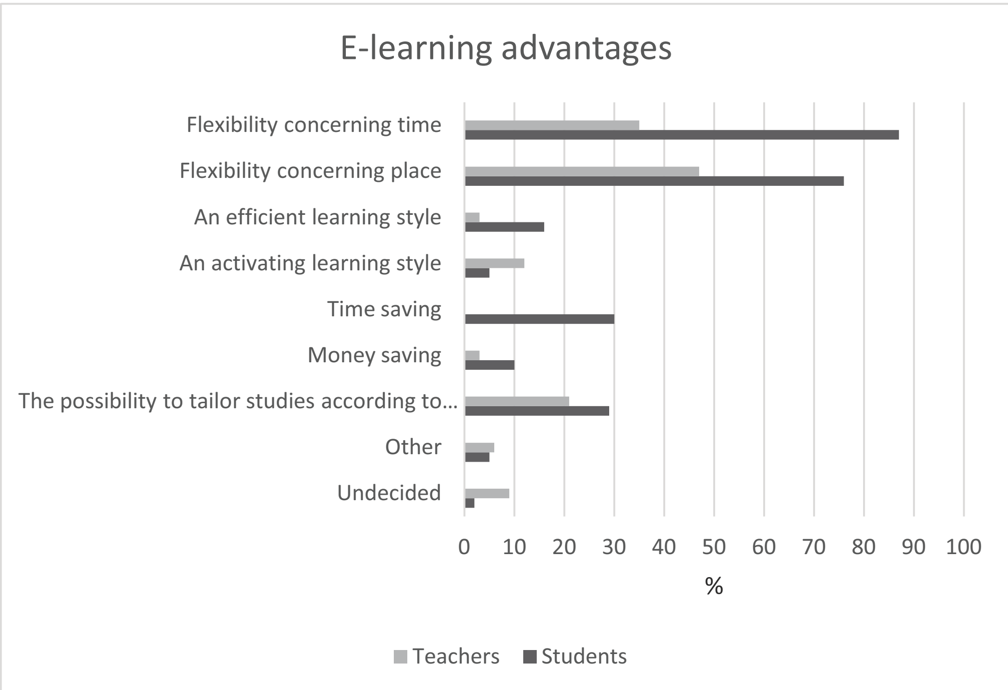


**Chart 2:** Student and teacher perceptions of e-learning advantages

## 3. Conclusions and Discussion

The results of the study contribute to an understanding of the features that should be taken into consideration in designing e-learning activities. There are some divergences in views between teachers and students when it comes to e.g. lack of technological or pedagogic skills, interaction between teachers and students and whether e-learning is time saving or not. Based on the study we suggest that in order to ensure the high-quality learning outcomes in e-learning continuous and relevant training and peer support for educators and students are needed. Additionally it is important to enhance the user experience of the devices and software. Further the content and materials of the courses should be designed carefully and content should be supportive and appropriate for each group. We also suggest that in e-learning the interaction between teachers and students as well as between peer students should be improved. As a future work we would like to conduct a field study observing the usage of e-learning tools in practice to gain deeper understanding of possibilities and challenges of transferring skills and knowledge by means of different e-learning applications.

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# From Concept to Practice: Helping Teachers to Create Effective Flipped Classrooms

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**Abstract:** This work-in-progress project is focused on helping university teachers to design and implement effective flipped classes. It is evident that the flipped classroom has become a core model of e-learning in contemporary teaching and learning. This pedagogy incorporates a group of learning strategies including blended and active learning. It is well documented if students are able to preview key concepts, face-to-face classes can be more effectively used for active learning. A 2012 University of Adelaide-funded flipped classroom project validated many of the professed advantages of this pedagogy. Teachers participating in the project indicated a clear willingness to use flipped learning. However, widely-shared obstacle identified by the teachers from this study, was a lack of confidence to apply concepts of flipped learning into practice. This may be the 'weak link' that's compromises flipped learning implementation. Therefore, as universities promote flipped learning as a contemporary teaching approach – there is an underlying challenge - that teachers are being asked to implement a pedagogy that many may not fully understand. Our work-in-progress project runs from February 2015 to December 2016. By implementing teacher development workshops, construction of an interactive website and developing flipped classroom resources, we aim to build staff capacity to use this e-learning approach to enhance their students learning experience. Twenty professional development workshops for some 350 university teachers across Australasia are scheduled during the project. Data from workshops run so far indicates 98% of participants felt more confident to design flipped classes, whilst 100% would recommend the workshop to their colleagues. Developing the 'Seven Key Steps to Flipping' has been a major outcome of the workshops and these steps are subject to peer review in subsequent workshops. This rigorous approach ensures a scholarly strategy to creating effective flipped classroom through its 'road testing' in a wide range of disciplines and institutions.

**Keywords**: flipped classroom, developing teacher capacity, blended learning, learning design

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The Australian Office for Learning and Teaching has funded this two-year research project that is focused on building the capacity of university teachers in undergraduate programs to design, implement and evaluate effective flipped classes. Since the early 1990s, the flipped classroom has increasingly become a core model of e-learning in 21$^{st}$ century education. The pedagogy incorporates a group of learning strategies including blended learning, just-in-time teaching and active learning. Contemporary educational research has consistently found that if students have the opportunity to preview key concepts ahead of class time, the face-to-face session can be more effectively used for active learning where these concepts are analysed and applied (McLaughlin et al, 2014; Herreid and Schiller, 2013; Karanicolas and Snelling, 2010).

A number of cross-disciplinary studies have demonstrated the positive impact of pre-class activities on student engagement in class and subsequent performance (Butt, 2014; Mason et al, 2013, O'Flaherty et al, 2015). This has reinforced the push to have less didactic lectures given in class time, and an increased drive to have student spend face to face time working on activities that have been previously given as homework. Having content-rich lectures available in more manageable online 'chunks' also allows students to preview and familiarise themselves with new material at their own pace and time, which is a widely promoted feature of contemporary eLearning.

Findings from a 2012 flipped classroom teaching project at the University of Adelaide, Australia, validated many of the professed advantages of this pedagogy. Analysis of feedback from teachers participating in the project's flipped classrooms workshops indicated a clear willingness to redesign their courses using flipped learning. However, a consistently and widely-shared obstacle identified by the teachers from this study, was a lack of confidence and 'know how' to actually translate the concept of flipped learning into real-life practice. Consequently, many teachers reported they felt anxious and reluctant to try flipping their classes, so generally kept to their familiar teaching methods. It could be said that this is the 'weak link' that continues to compromise flipped learning implementation. This issue has also been highlighted in flipped classroom papers by Findlay-Thompson and Mombourequette (2014), Berrett (2012), and Bergmann and Sams (2012).

Therefore, as universities continue to promote the flipped classroom as a strategy that facilitates both student engagement and a contemporary approach to higher education – there is an underlying challenge. This challenge is that teachers are being asked to redesign their curricula with an approach that many may not fully understand whilst at the same time juggle (or struggle) with new learning technologies.

Our current work-in-progress flipped classroom project runs from February 2015 to December 2016. Through the implementation of teacher development workshops, construction of an interactive website and development of flipped classroom resources, our project aims to build staff capacity and confidence to use this blended learning approach to enhance the learning experience of their students. Furthermore, a key aim of our project to establish a network of champions in flipped learning across our national higher education sector to sustain the momentum into the future and provide mutual support through this type of community of practice.

More than twenty professional development workshops involving approximately 350 university teachers from a range of disciplines across Australia and New Zealand will be conducted throughout the project. The one-day workshops model a typical flipped class experience, asking those attending to undertake a pre-workshop activity in the same way that their students are asked to engage ahead of the face-to-face class time. Participants were emailed 10 days before their scheduled workshop and asked to watch a short video (the link was attached to the email) and then submit their opinions and responses via an online survey tool, with a 'due date' for submission 2 days before the face-to-face session. This allowed the teachers to reflect on their motivation to complete the pre-activity, and allow them to evaluate the design, accessibility and timelines associated with the task. At the start of the workshop, outcomes of the pre-class were presented and discussed, reinforcing and modelling the need to embed the pre-activity into class-time. Rich debate about the reasons why some people did (or didn't) undertake the task (which took about 15 minutes and included submitting responses via an online survey tool), was a common feature of most of the workshops.

As in any good flipped learning plan, input from participants in the pre-activity formed the basis of the program. Those teachers who did not complete the pre-activity were not precluded from participation, but reported that they felt less prepared than those who had completed the tasks – again, providing the audience with the 'authentic' experience of what would commonly occur in their own flipped classes.

Maintaining the approach of modelling a flipped class, the workshop facilitators then presented a series of 'mini-lectures' interspersed with group activities. Exemplars of effective active learning strategies used in the face-to-face 'phase' of the flipped classroom were also featured. This modelling approach is a strategy for teacher capacity building that has been consistently advocated in the literature (Chickering and Gamson, 1987, Fullan & Scott, 2009). It has been reinforced as a specific focus to developing online teaching skills by Dede et al (2008) from the Harvard Graduate School of Education. Supported by immediate facilitator feedback and constructive peer review, the teachers were guided through their own flipped class planning, based on the 'Seven Key Steps to Flipping', which has been developing across the life of the project. It serves as a template, particularly for novice 'flippers', to help blueprint the pre-class, in class and post-class phases of the flipped classroom pedagogy. The ultimate aim of our flipped classroom workshop was that teachers would leave at the end of the day, having had the opportunity to design a new flipped class plan or review and improve a previous session.

Teacher preparedness to design and run flipped classes after our workshop and their students' levels of engagement and motivation is being evaluated using post-workshop and follow up surveys. Evaluation of teacher confidence of motivation to run flipped classes after our workshops will be correlated with levels of engagement, motivation and progress in their students, who will be surveyed after undertaking the resulting flipped activities. Data from post-workshop surveys from 10 Flipped Classroom Workshops run by the project team from May 2015 – April 2016 is presented in table 1. It is evident that there was a positive perception of increased capacity to design flipped learning activities. Furthermore, it indicates that participating in the workshop has helped to prepare a majority of the teachers to flip one or more of their classes in the following semester.

Important in any project is longer term sustainability. The development of a network of flipping champions is evolving through follow up from the workshops, and a Flipped Classroom Symposium planned for November 2016 in Adelaide will bring together over 200 university teachers from Australia and New Zealand to continue the momentum that the project has begun.

**Table 1:** Participant responses to post-flipped classroom workshop survey (n=134; 86.5% response rate)

| The Flipped Classroom Workshop: | % of responses in the categories of to a moderate and to a great extent |
|---|---|
| helped me to design flipped learning activities for a topic | 100% |
| involved me in applying key concepts for designing flipped learning activities | 100% |
| helped me to work out what I need to focus on when designing flipped learning activities | 96% |
| provided me with immediate feedback that helped me design flipped learning activities | 100% |
| enabled me to work at a pace that matched my experience | 89% |
| was relevant for academics involved in designing flipped learning activities | 93% |
| has adequately prepared me to flip one or more of my classes next semester | 91% |
| Is a staff development approach that I would recommend to colleagues | 100% |

The ongoing development of the 'Seven Key Steps to Flipping' has been a major outcome of the projects, and these steps are subject to ongoing peer review in subsequent workshops as well as on the project website http://www.adelaide.edu.au/teaching-projects/flipped-classroom/. This approach will contribute to a robust, evidence-based strategy to creating effective flipped classroom through its 'road testing' in a wide range of disciplines, class sizes and institutions across the sector.

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# Utilization and Benefits of YouTube for the Educational Purposes: a Review Study

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**Abstract:** Social software applications can be used as an important element in the process of education. YouTube, as a Web 2.0 tool, can be utilized by modern society through observation and social cooperation and interactions. YouTube and shared videos are opening new ways used for educational process. Students are motivated to getting new knowledge with the up-to-date channel for communication and sharing of the materials. The goal of this study is to explore the benefits of YouTube with respect to their use for the educational purposes. YouTube is classified as a content based social network. The profile doesn´t play such an essential role as profile on Facebook. One of the key benefits is that content based social networks are usually accessible to all without necessity to create an account. Other benefits are sharing materials, higher students' involvement, and demonstrations in form of video, music or pictures. The methods used for the analysis included a method of literature review of available sources in the acknowledged databases such as Web of Science, Scopus, Springer, ScienceDirect or Google Scholar exploring the issue of YouTube with respect to educational purposes was used. Furthermore, other sources cited in the analysed studies were also examined. Secondly, on the basis of evaluation of these literature sources, the researched issue was explored. The review study is beneficial not only for academicians and students, but also for the business community. They can profit thanks to the shared materials.

**Keywords:** analysis, benefits, database, review, YouTube.

## 1. Introduction

Social networks play an integral role not only in personal life but also in education. YouTube is in personal life used for playing movies, songs and demos. Samples of recordings that can not be demonstrated in the classroom, unusual situations and common themes can be used in the educational process in all spheres of the education. Speakers from various educational institutions or businesses may want to present their knowledge and engage new students or customers, for example. Technical innovations are connected with advanced technologies. They allow to watch YouTube not only on computers but also on tablets or on mobile phones or other advanced devices. The number of social networks users is still rising. Main players on the world market are Facebook in the group of profile-oriented network and YouTube in content-based networks.

The organization of the paper is as follows: firstly a theoretical background with focus on definitions of key terms like social media and social network is provided. Then research methodology is described, the key part brings results from the literature review in the official databases which was run at the beginning of June 2016 from the Faculty of Informatics and Management, University of Hradec Králové. Examined areas relate to the use of social software applications, specifically YouTube for study purposes, pedagogy and perceived benefits. Conclusion summarizes the findings.

## 2. Social media and social networks

Social media can be defined as web-based services that allow individuals to construct a public or semi-public profile within a bounded system; articulate a list of other users with whom they share a connection; and view and traverse their list of connections and those by other within the system. (Boyd and Ellison, 2008)

One of the fundamental division of social networks is to divide them on the profile-oriented and content-oriented. Profile-oriented networks are Facebook, Google+, Lidé.cz, Myspace, vk.com. These are mainly focused on persons. Profiled networks usually require to create user profiles that allow people to interact with other people, create groups, share opinions, share data, send links, access and share contacts, create social ties and the like. Between content-oriented social networks can be classified YouTube, Flickr, Last.FM or Souncloud.com, former classmates, Slideshare.net. As the name itself says they are focused on the content. The profile goes away, but some content-oriented social networks require creating a profile to allow users to see and use wider offer of tools.

Next definition is based on 'electronic communication'. Social media are a form of electronic communication, through which users create online communities to share information, ideas, personal messages and other content (videos). (Social media)

### 2.1 YouTube

YouTube was founded in February 14, 2005 in San Mateo, California, USA.

Social network YouTube is primarily focused on inserting and watching videos. Profile does not play here a major role, but YouTube after creating a profile offers utilization of additional applications, such as embedded videos to the queue. The principle of service is simple: Anyone can register for free and share videos or movies with other users. Economically, the project stands on advertising, which displays the server along with the projected film. To make advertising more effective videos cannot be downloaded onto a user's computer, it must be played from the server. However, there are a number of servers and programs that help to circumvent this limitation. Monthly YouTube is visited by more than 1 billion users and users view more than 6 billion hours of video. 100 hours of videos are uploaded to YouTube every minute.

## 3. Methodology and goal

As it is a review study, secondary sources were used. A method of literature review in the databases Web of Science, Scopus, ScienceDirect, Springer and Scholar Google was used by searching for articles and information. It was searched also in Research Gate but there is not written the number of results and it is not possible to specify what exactly to search in the articles (in key words, title, whole article etc.). Due this reason results from this database weren´t presented. The searching was done in the first week of June 2016. The focus was aimed at the YouTube, Education and Benefits and Pedagogy. The key words were as follows:

- YouTube and Education
- YouTube and Education and Benefits
- Youtube and Pedagogy

Then it was necessary to select, categorize and update available relevant information from the collected published material. A method of comparison and evaluation of findings was used.

*The goal of this study is to explore the benefits of YouTube with respect to their use for the educational purposes.*

## 4. Results

This part contains the basic results of the searching articles in the five important and respected databases.
Results are divided into two groups. The first one is larger. There were found/identified only two key words. In the second one were found three key words. The results are presented below. What was searching for in the article is written in the brackets.

*YouTube and Education*

- Web of Science (topic) = 466 results
- Scopus (title, abstract, key word) = 558 results
- ScienceDirect (title, abstract, key word) = 65 results
- Springer (with all of the words = YouTube , with at least one of the words = education) = 8 332 results
- Scholar Google (with all of the words) = 666 000 results

*YouTube and Education and Benefits*

- Web of Science (topic) = 38 results
- Scopus (title, abstract, key word) = 50 results
- ScienceDirect (title, abstract, key word) = it is not possible to present it. In the searching field it is possible to write only two terms. When searching for YouTube and Benefits = 4 574 results
- Springer (with all of the words = YouTube, with at least one of the words = education, with the exact phrase = benefit) = 4 766 results
- Scholar Google (with all of the words) = 143 000 results

*Youtube and Pedagogy*

- Web of Science (topic) = 35 results
- Scopus (title, abstract, key word) = 63 results
- ScienceDirect (title, abstract, key word) = 20 results
- Springer (with all of the words = YouTube , with at least one of the words = pedagogy) = 1 356 results
- Scholar Google (with all of the words) = 31 700 results

The biggest database with the highest number of articles is definitely Scholar Google. It is followed by Springer. Databases Scopus and Web of Knowledge are closely evaluated with the number of articles. The smallest number of the results was found in Science Direct. More article are focused on the topic YouTube and Education than on YouTube and Pedagogy.

In the next part we will focus on the closer topic, findings from second search (YouTube, Education and Benefits). In the databases there are several articles connected with health and medicine. For example in Web of Knowledge there are nowadays 8 articles from first 10 paper focused on the medicine and health (see fig. 1). To be precise 13 articles out of 38 articles dealt with medicine or health topic. In Scopus there were 12 articles out of 50 which were focused on the education, medicine and health. Next group of the articles is closely connected with higher and university education.

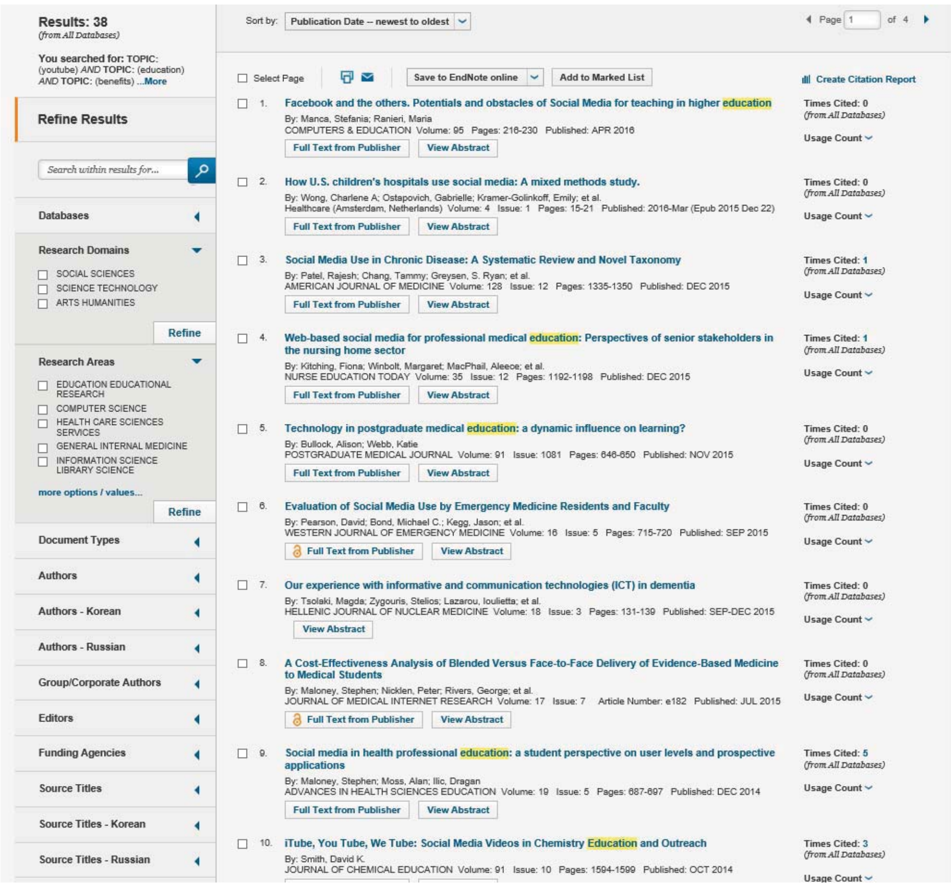


**Figure 1:** Up-to-date sources in databases Web of Science

Most of the articles that were found in the databases Web of Science and Scopus are not free accessed. The next problem that is connected with the publication is that it is not focused only on YouTube but on the social media or social networks as the group. Manca and Ranieri (2016) focused on social media. Their survey addressed to the Italian academic staff. Overall, the results emphasise ambivalent attitudes towards the benefits and challenges of Social Media in the context of higher education with obstacles prevailing over advantages. Aaijaz et. al (2013) writes about the benefits of Web2.0 in education. A total of 455 students and lecturers from higher learning institutions in Malaysia participated in the study Balakrishnan (2014). Multiple linear regressions revealed five factors: E-Learning Perception, Academic Reasons, Ease of Use, Convenience and Social Networking to be positively associated with Teaching and Learning Benefits obtained from the use of social networks. Patrut (2013) focused on the advantages and disadvantages of video sharing in education. Nord et. al. (2014) focused not only on the benefits in education but also in the businesses.

The results of Szeto et. al. (2016) reveal the teachers' pedagogies built on three instructional strategies with four preferences for the use of social media. Among the social media tools, YouTube was commonly used with other social media and non-social media tools, particularly for teaching in secondary schools. Consequently, three forms of pedagogy-the direct, constructivist and participatory, were identified in the digital-native preservice teachers' instructional strategies of integrating potential social media affordances. Al-Bahrani et. al. (2015) in their study examine the students' view of incorporating social media in the classroom. Students have the strongest presence, in descending order, on Facebook, YouTube, Instagram, and Twitter. However, based on their utilization preferences, these mediums are ranked as follows: Instagram, Facebook, Twitter and YouTube. The results indicate that students participate if social media is a voluntary part of class. The survey indicates that students use their social media accounts more frequently than email or Learning Management Systems.

The most often perceived benefits in the literature for video sharing in education were (Video Sharing and Blogging in Education):

- Offers Subject Specific Tutorials
- Sharing is an easy upload process
- Various video formats are accepted
- Users can post a link to a site or blog about a video
- Users can share their work to the world
- Users can interact with a global audience
- Convenient
- Helps students organize and reflect learning processes
- Offers Self-Evaluation

## 5. Conclusion

Social Media tools and also YouTube are seen by many students, teachers and expertises as powerful drivers of change for teaching and learning practices. Using video sharing services in education makes sense, because digital media in education makes sense. In the utilization there is important openness, interactivity and sociability. Even though a lot of surveys on the use of social media have been done, most of them are focused on social media as a whole. There were not done/published enough investigations which would be focused only on the benefits of the utilizaton of YouTube. There are almost missing articles focused on financial and economic education. For this reason, the author finds potential for further exploration.

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# Developing the Concept of Russian Open Education Platform

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**Abstract:** In 2015 the National Open Education Platform has been started in Russia in response to global challenge from rapidly developing foreign MOOC platforms. The project created by eight leading national universities with support of the Ministry of Education and Science of Russia aims to improve quality, usefulness, and availability of Russian education. The article describes experience of implementing e-learning in Ural Federal University exploring the basic issues which arose while using open on-line courses in the university educational process. Economic and other effects of open education development for the university have been assessed. The authors have described different models of entering the open education market either as developers of open on-line courses or consumers of a new educational product. Risks, existing barriers, and possible options of further growth have been analysed. The article contains description of specific practices which can be used to increase open education efficiency or the rate of development of this area in a university.

**Keywords:** e-Learning, massive open on-line courses, National Platform, university, open education

## 1. Introduction

Open education is becoming a reality all over the world due to the development of e-learning technologies. The term "e-learning" emerged in the early 1990s, and was introduced into the Russian legislation in 2012. Although open education is a huge success, its rapid development led to the practice outrunning the theory (Deimann et al, 2013), which resulted in the insufficient use of scientific data during the implementation of projects. This gave rise to a variety of formats of educational products. With regard to the concept of development of the Russian Federation Open Education National Platform, and the Ural Federal University being a party to its creation, we analyse empirical experience, which helps in determining the strategic development priorities.

## 2. Discussion

At least three components are required for the National MOOC platform to develop as an effective educational resource:

- cooperation among the universities developing the courses in order to create and implement educational products;
- consumers of educational products and services, ready to interact with the content actively and systematically;
- economic and financial basis ensuring the project’s sustainable development.

Experience and forecasts may be systematized using the analysis of the processes related to the formation of these components. The detailed processes of creating the educational courses, their promotion, structuring, etc. are outside the scope of our research We focus on using open on-line courses in the university educational process.

### 2.1 Forms of cooperation among universities

E-learning is one of the areas where the cooperation of universities, including Russian ones, is economically and substantively justified. It allows to reduce the operation costs of expensive platforms for open on-line courses and to accelerate the processes of modernizing education in universities. On-line courses make virtual academic mobility possible without any financial costs and complex logistics of the educational process. The MOOC technology involves multiple use of the high-quality content once created. Every university needs to have it created, but it is impractical for the universities when they are autonomous. First of all, it concerns basic courses with practically the same content in different universities.

Different countries decided on different forms of cooperation among universities in the area of e-learning. For example, in China, France, and India the key role belongs to the government, which selects the universities tasked to create the content of courses, whereas the US universities joined their forces themselves.

Discussions on the forms of cooperation among the universities are still being continued all around the world. So, in 2015 the Danish Ministry of Education has launched an initiative to "take on more than a supporting role" and to increase the degree of MOOC formality (Baas et al, 2015). In Russia a mixed model is implemented: the leading universities' initiative in the development of open on-line education received government support from the Russian Ministry of Education and Science. The universities established the National Open Education Platform Association, which became the main mechanism of such interaction. The Association became a tool for joint investments into creation and development of the platform, establishment of uniform requirements for the courses' quality, external motivation of the universities.

### 2.2 Consumers of educational products and services

Contemporary society is changing the model of a learner (Chernykh, 2012). The learner is required to be motivated and capable of continuing constant education (for example, the Lifelong Learning concept (Osborne et al, 2014), to be able to systematically learn new information according to emerging problems. Serikov (2012) talks about the strengthening of the position of a learner as a subject of their own education, capable of planning content, technologies, and forms of receiving it.

In response to these principles the educational platform should submit a product that meets the "liquid modernity" parameters (Bauman, 2000). One of the options to achieve the desired product features is presented in the connectivism approach (Bell, 2011), with its idea of organizing and improving connections between the blocks of information. It marks the "painful points" in structuring the content, which is required by learners, and shows the need for retraining teachers and restructuring their professional paradigm.

Nowadays it is difficult for the average Russian to get high-quality higher education. The outflow of teachers from the universities, the gap between the generations of teachers in a number of "applied" areas (such as construction, economy, PR, etc.), the reduction of school training level had adverse effects on it. The priority objective of the National Platform of Open Education project in Russia is to improve the quality of teaching basic Bachelor courses in all universities ensuring the formation of the basic competencies established by the federal state educational standards.

The Russian legislation allows the implementation of two models of integrating on-line courses into the higher education system to grant the learner the independent option to choose the way of learning. The first model involves the learners' studying MOOCs independently with subsequent credit transfer by the university, where they study the educational programme. The second model is related to studying on-line courses of another university as a part of the educational programme. The second model is implemented both through the agreements between the universities, and by means of giving the learners a grant for them to independently choose the place and the way of studying a part of the programme.

Over 80 courses had been created for the first year of the platform operation. The first experience of their use in the educational process showed a positive impact on the students' learning outcomes even when the traditional format courses were fully replaced with on-line ones. Here the need appeared for preserving the face-to-face contact of students and tutors, who help the learners in organizing the work with the on-line course. About 70–90 % of learners successfully finish on-line courses as part of a higher education programme, whereas for all learners this figure reaches only 15 percent.

### 2.3 Economic aspect of the National Open Education Platform

Openness of e-learning implies free unlimited access to the educational resource, regardless of the learner's level of education, age, location, financial abilities, and formal status. Thus the process of creating the national educational platform is labour-intensive and time-consuming, and therefore requires to be interpreted in terms of creating a sustainable financial model (Business Models for Online Higher Education, 2013 or Basovskiy, 2013),

The basic costs of the implementation of educational programmes with the use of e-learning include the following:

- costs of creating and maintaining the functioning of the platform, where the courses are placed;
- costs of tutor and technical support of the course (if intermediate and final examinations are automated, these costs have no direct correlation with the number of learners);

- payment for the job of proctors and assessors on conducting on-line examinations, and costs of person identification technical support;
- payment of the general organizational costs of the educational process administrative support.

Besides, the course implementation should provide for a return on investments into its creation and continuous update (Bystrova et al, 2015). Here certain proportions of payments may be divided between a university/an investor, and the authors of the courses. It makes the latter motivated to create a high-quality product.

The economic potential of using MOOC in the educational process is great. If the cost of studying an open on-line course and undertaking person identification measures ranges between $10–30, the reduction of the net cost of implementing parts of the educational programme in an average Russian university may range from 25 to 75 %. The costs of creating and implementing on-line courses at the expense of the economic potential of their use are not that easy to cover. The economics of e-learning is built on mass inter-university application of the courses created, but the Russian education system provides no convenient mechanisms for financial settlements among the universities. Nowadays there are two approaches to solve this problem: the first one is to develop the forms of contractual relations among the universities; the second one is to transfer the funds for implementing the part of the educational programme to the learner, who makes the decisions on choosing what courses to study. Both approaches are being tested and, most likely, will complement each other.

Acting both as a supplier and a consumer of educational programmes, in 2015 UrFU got an experience of using agreements on the network form of implementing educational programmes. Over 500 students finished on-line courses that had been included into the basic educational programmes. The cost of studying the courses was reimbursed by means of cutting the costs of implementing the educational programmes inside the universities. The saved funds have been directed for changing the teaching methods in other parts of the educational programmes, in particular, for the introduction of project-based learning.

## 3. Conclusion

The National Open Education Platform establishment has become an important milestone in the e-learning development in Russia. It has created the conditions for students of any educational institutions and private customers to choose on-line courses from leading Russian universities and transfer credits to their educational programmes.

The initial empirical experience of the platform developers has revealed strengths and weaknesses of the on-line courses, as well as barriers and risks of using MOOCs in educational programmes. Further development of the project requires the feedback analysis and the theoretical understanding of the students' learning processes based on big data analysis. This will allow a methodological approach to be developed for improving the MOOCs quality and increasing the effectiveness of e-learning in high education programmes.

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