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The principles and approach support the mapping of the personal study pathway in electronic educational environments

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Abstract

In this paper the authors examine the theoretical background of formation of personalized strategies in electronic educational environment. It is assumed that personal study pathway is a conscious "design" of the student competence profile. The article designates parameters, which later will form the basis for constructing model of personal study pathway. Therefore the paper consists of several sections that propose (1) general topics of the approach; (2) the principles and the general model for supporting of mapping of the personal study pathway in electronic educational environment; (3) report on approach application in progress

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1. Introduction

Currently, one can easily state that the major objective of the modern education is to get a person prepared for living in the rapidly changing world with its global-oriented multi-cultural environment. In its essence, global education unites various educational systems and models, based on divergent cultural, religious, philosophical outlooks. Building up a unified educational environment is one of the top priorities for the nearest future. However, this is not an easy task, based on preserving national identity on the one hand, and involving cultural and educational

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integration on the other. Today's concept of education means lifelong learning⁵⁻⁶. These processes cause the knowledge-based approach in education to be gradually replaced by competence-based one.

Nowadays we can witness a number of educational processes migrating into the Internet and, consequently, them becoming more transparent and more or less multi-cultural¹. However students of different cultural backgrounds do not always share the same vision of the learning process: they have different world patterns, information processing strategies, types of educational discourse etc. The article outlines several formal representations of the learning process and its implementation in electronic educational environments (EEE).

It is obvious that with the application of electronic educational environment (EEE) the didactic functions of a tutor will be changed, and the whole educational process will become autodidactic. And before mapping a personal study pathway, one must decide how this individualistic approach will be applied in EEE where there is no immediate communication between students and tutors. When studying via the information technologies, a student is supposed to develop individual learning skills and to get well acquainted with the up-to-date on-line education technologies, which means that the student's self motivation becomes a more important factor.

When a student interacts with EEE fulfills several important functions³:

- Informational, i.e. providing access to various kinds of information, both educational and legal.
- Motivational, i.e. creating and sustaining comfortable environment for the study process, allowing planning and controlling a student's individual activities, as well as a tutor's professional ones.

We believe that the content of EEE will be derived according to the output rules, adjusted to a student's cultural and cognitive specifics. As a practical output, we intend to propose a methodology of mapping a student's personal study pathway in a multicultural learning environment.

In this paper the general topics of the approach are proposed. The paper consists of 4 sections, which propose (1) general topics of the approach; (2) the principles and the general model for supporting of mapping of the personal study pathway in EEE; (3) report on approach application in progress.

2. The general topics of the approach

From our point of view, in order to develop custom approach in education for an electronic education platform it is necessary to set several modules (stages) for composition of most optimal model of education for each student. In the first stage of interaction with digital educational platform, it would be most appropriate to conduct criterion-oriented test, which would not only determine cultural-cognitive profile, but also collect information about other basic characteristics, such as: motivation, educational background, informational and communication technology skills, professional interests. However, it is necessary to take into consideration the possible dynamic nature of before mentioned variables. It would be rational to retest an individual periodically, and make corrections to the selected education course. Collected information should be used to compose custom courses with most appropriate educational method selected for each student. As for didactic functions of EEE we would like to point out a possibility for a student to "teach" the system. One variant of such system: intellectual component of system analyses both collected data from conducted tests and student's reflections about courses he/she has completed. If it is necessary it amends selected educational strategy, basing on analysis result. Then, there is an aggregation of statistical parameters in data warehouse, which will allow perceiving various trends. Moreover, accumulated data would be used in the process of tailoring education experience to new students in the earliest phases of customization. In other words, it would be used on the stage of adaption of learning method and content with a consideration to peculiarities of cultural cognitive profile of a student. We assume that educational content in EEE would be presented according to personal output rules, formed by cultural cognitive profile of students. (fig. 1)

Worth noting that the way cultural-specific personal education course is formed in the system to a various extent could be affected by a tutor's role in the process.

Also, there would be an option to construct or adjust personal education course using various recommendation services, which will propose most appropriate courses for a particular student and point at a possible difficulties that can be encountered by that student during education at courses from without recommendation zone. Tasks and workbooks at a particular course could be graded in the similar way.

We assume, that with this approach a student will mostly use information handling techniques best fitted for his/her own style in the learning process. It is worth noting that both internal (from own faculty or university) and external courses could be graded and presented to a student this way, with system providing student with recommendation on his/her competence profile improvement using all relevant and available sources.

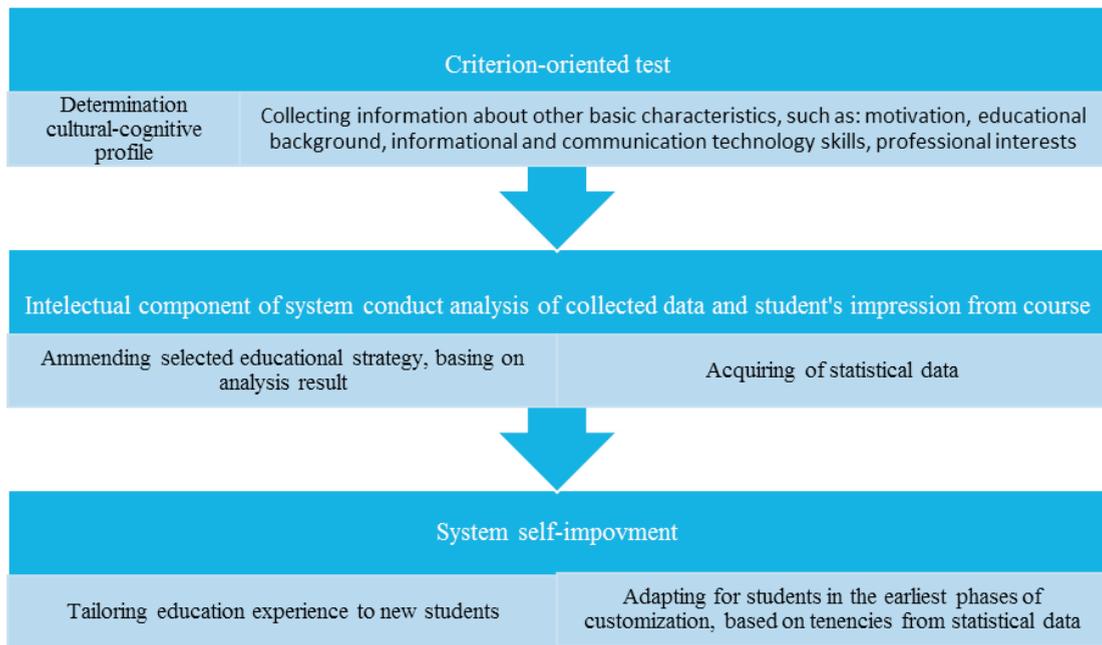


Fig. 1. System work process

In the end, completion of such personal education course would form up a certain competence profile of a specialist.

From our point of view, customization of educational experience in electronic educational platform would be rational to implement with acknowledgment of a particular student's peculiarities (cultural cognitive profile) at start and formation of a model of a competence profile, taking into account the specifics of not only cultural cognitive profile, but also all kinds of testing systems and tutor methods as a follow-up to the customized educational content.

The specifics of various processes involved in education are ought to be noted when pointing out characteristics of a cultural cognitive profile. Generally speaking, there are two components in educational activities - cognitive and operational. Cognitive component consists of a peculiarity of cognitive style, specifics of choice and interaction with information, a peculiarity of using creative approaches to educational activities. Operational component includes such concept as time-management, social position, also attitude taken to instructions, guides, outer environment and teamwork.

The principles by which flexible courses are formed are mostly related to the principles of constructive learning.

According to peculiarities of a certain cultural cognitive profile and the level of mastery of a course's basics (the ideas behind formation of the latest has been discussed in detail earlier in the text), courses should be composed according to module principle, as a multi-level teaching system that adapts to inputted level of knowledge. Speaking of various forms of education material's presentation, it would be the best to implement options for interface manipulation, classification of content type (video, visual, text, mixed) and means for skill attachment (from reproduction of acquitted information to self acquisition of it and creation of a new knowledge). The level of a tutor's guidance and involvement in process could have a remarkable role in making course more or less interactive. In theory, we have described all these aspects in the principles of cross-cultural multimedia didactics.

3. The support of the mapping of the personal study pathway in EEE: principles and general model †

To conduct the formation of a personal study pathway that is focused on achievement of one's professional life goals, it is necessary to form a number of models and formulate their feasibility in the electronic educational environment.

Mapping and implementing of Personnel Study Pathway is a complex process that includes the following components:

- Forming an individual information space.
- Personalizing educational resources.
- Personalizing educational objectives and finding means for their achievement.
- Adapting educational content and interface in EEE.
- Achieving synergy effect through combining individual reflection and self-organization capacities.

Conceptual model of student behavior on the specific selection of their future professional field, which would require certain competences. It is important to consider two typical choice models: 1) On the basis of labor market demand of specialists with level of possibility of forecast 2) On the basis of overall objectives of the professional life that could be: earnings funds to implement their goals in life; opportunities for self-realization, provided by selected profession; needs for socialization. Interesting to note, that it is the observation of professional life from the position of general goals in life that shows a contradiction of lack of time to achieve not professional, but life goals, using professional only as a tool. The second strategy is preferred because it makes it possible to form a space of professional choice depending on achieved competencies. The specified theme closely connected with the development of approaches to management and decision making in ill-structured (complex) situations to which the situation of planning of future competencies belongs. Accordingly, as part of the works of our research group in addition to developing the principles of individualization we are also developing methods of structuring knowledge about complex situations (e.g. in the form of formal cognitive maps) for subsequent analysis of the dynamics of the situation in different circumstances and consequences of the adoption of certain decisions.

It is important to take into account the willingness of the student to the selection, since the choice is often associated with the opposition of alternatives. Student should be ready for such a choice, and the tutor must have a fairly complete student' profile to guide him. In particular, it is necessary to monitor the degree of uncertainty and incomplete of knowledge about professional field, which varies in the learning process. Then we can define the settings for the purpose of the educational environment and the type of learning strategies, depending on the personal profile, the degree of uncertainty and incomplete knowledge about professional field, readiness for selection. Thus e-learning environment is a universal information space, which is configured in a certain way depending on the type of user and his level.

Table 1. Partial systematization of strategy types.

Level	Main role of EEE	Strategy type	Willingness to the choice	Type of choice	The degree of incompleteness and uncertainty of knowledge about professional field
Elementary	Familiarization with a wide range of professional fields specialty associated with some theoretical knowledge. The forming in the education net of the small group "knowledge surfers"	Surfing	_____	Emotional	{Hi} by theoretical knowledge and for practical skills.

* Some of the results presented in this section is partially supported by RFBR grant number №14-07-00821

Pre-intermediate	Possibility of more in-depth study Research activity. Information interchange.	Surfing + Active choice	Low	Emotional + Adaptive under tutor control	{Medium} by theoretical knowledge. {Hi} by practical skills.
Intermediate	Supporting of the tutoring and small social group for learning of choosing courses. Knowledge interchange.	Active choice + Knowledge transfer	Medium	Goal-setting	{Medium} by theoretical knowledge. {Medium} by practical skills.
Upper-intermediate	Application of skills to real problems. Tutoring.	Knowledge transfer + Application of knowledge and skills	Hi	Strategic	{Medium} by theoretical knowledge. {Low} by practical skills.

Mapping personnel study pathway is a step-by-step (iterative) procedure where the order of its above-mentioned components must be determined on the basis of a student's interim achievements. Developing the whole personalization process is supposed to follow two major directions: vertical and horizontal. In its vertical direction, Personal study pathway will consist of operations and activities component, representing an algorithm of achieving the education's objectives. In its horizontal view, personal study pathway represents the "human dimension", formulating and fulfilling the educational processes within EEE.

Ultimately, we expect that there will be another participant in the process of in the creation of the educational environment - an employer who inputs the desired specialization in the form of a set of competencies in the system; then, a system offers him a set of relevant courses or students. In the future, we think that any profession can be described in these terms as a competence model.

The main functionality of support system of the mapping of personal study pathway in EEE from the perspectives of role model should include adaptation functions, such as:

- 1) The functions for supporting student learning process in active electronic educational environment
 - The mapping of personal study pathway including to support of the different level of selection (several functions);
 - Planning of the educational process according to the choice;
 - Execution and control of the strategy.
- 2) The functions of interactive support of tutor's work
 - Tools for detection and construction of systematic linkages between courses and competencies
 - Tools for monitoring space of the course that is manifested as a relation between actual knowledge and the results of didactic processing of such knowledge for a certain specialty, which are synchronized with the applied aspect (practical utility).
- 3) *The functions of interactive support based on several i-agents.* In such case, electronic environment is built on some repository of all teaching materials or virtual links to them in the system of curriculum's courses. Therefore, the necessary functionality of such information-analytical system based-on-i-agents for the dynamic formation of EEE will contain the following: search, surfing, recommendations, and navigation.

As for other users of the system, apart from the direct users of EEE who support the learning process, it is worth noting the possibility of participation of methodists and professional associations (or, in other words, "consumers" of graduates), which can enter new market position in the system, using "language" of competencies or to find the closest set of courses for optimal specialization or even correction of existing courses.

3.1. Conceptual model of electronic educational environment

There are several essential components of conceptual model of e-learning environment and its users such as sets of courses, model of competence profile of curriculum made from courses, model of competence profile of a certain course in curriculum in relation to the competency profile of the entire curriculum, model of virtual learning environment, model of labor market of specialists, based on certain competence programs.

Our approach to forming EEE is aimed at supporting cross-cultural communication ² and the flexibility of individual strategic planning of a profile of competences. *Basic models for formation of personal study pathway:*

- *Model of competence profile of student.*
- *Model of tutor and smart-tutor* as an intellectual computer agents in system.
- *Model of a student communication environment*, which includes every intractable tutor (and other students) who supervise courses and indirect tutors (leading scientists lecturers, representatives of the business community that apply knowledge from the discipline), who are selected in accordance with the three-element model of the course program. This model can be visually presented this way- a student in the center, next is the circle with tutors associated with the basic competencies that are representing maximum number of various professions, next is the circle with tutors associated with the advanced and specialized competencies, next is the circle with indirect tutors.

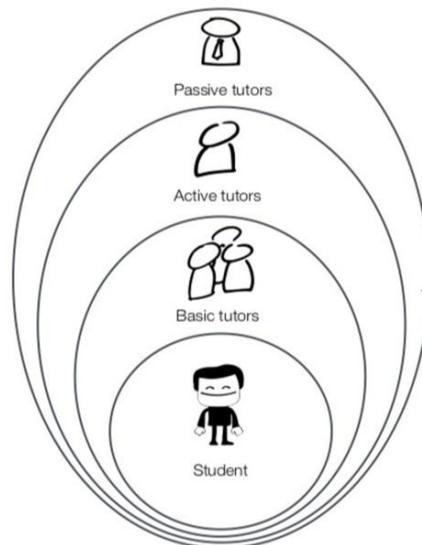


Fig. 2. Model of a student communication environment

It is necessary to implement possibility of monitoring information from indirect tutors too. This can be done using intellectual computer agent, which will be seeking relevant offline and on-line events (lectures, seminars, workshops). Therefore, basing on the model of communicative environment an intelligent agent – smart-tutor is constructed. The smart-tutor would be in charge of tracking recommendations from tutors, plan communication, collecting recommendations on additional events, creating summary tables of important events.

(1) *Model of curriculum includes system with courses interconnected with each other and with competence profile and a model of labor market of graduates of that course.* Each course in the curriculum should be presented as a three-element model of the knowledge and skills associated with the competency: knowledge and skills from the basic course; Additional theoretical knowledge and skills relative to the objectives of the course and competence focus, the source being active groups (scientists or practitioners) that generates new knowledge, practical knowledge about the level of application of skills, the source of which are typical representatives of the companies. In

particular, the basic departments of universities are the representatives of the labor market for graduates, attempting to synchronize competencies obtained during the learning to the competencies demanded on the labor market.

Each course in the EEE should be represented as a core set of teaching materials in the form of presentations to lectures, videos, lectures and seminars, interactive materials, an additional set of recommended materials online active groups which generate new theoretical and practical skills and knowledge in this field.

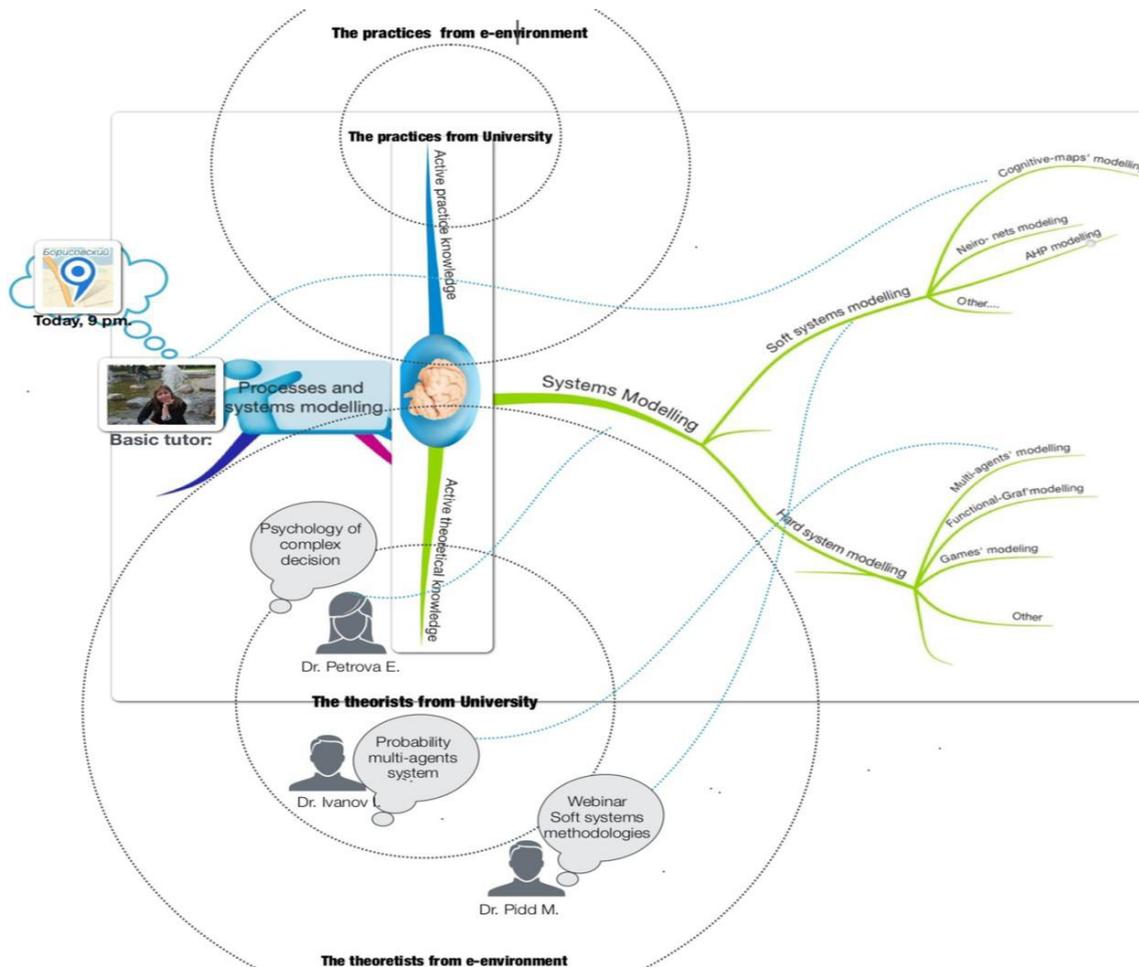


Fig.3 The illustrative example

(2) Model of competence profile of curriculum $MK_p(U_i, K_o)$ includes:

- Model of relations between courses U_i from the perspective of mastering certain competence. In particular, for such a multidisciplinary profession as "business informatics", oriented to prepare a range of specialists - this would be presented as a network model that can be constructed using the methods of data-mining, handling text courses.
- Model of accumulation of amount and quality of competences in relation to each of the possible specialization of labor market of a particular course
 - Model of competence profile of curriculum U_i is a model of the relationship between knowledge, skills obtained and competencies.

- *Model of competence-profile of labor market of the curriculum graduates* is a “summary” of competencies that determine the possibility of taking every competence on the labor market. Accordingly, if the selection criteria of various academic disciplines are inputted, it becomes possible to receive a slice of the full set of vacancies. Specific professions on the market can be considered as a qualitative scale, which measures the level of professional success. Moreover, apart from such representation of the future professional activity of the student, we would like to implement a system that would take into account some personal parameters associated with the psychological, cognitive, communicative personality characteristics, which influence the choice of life goals

4. The some notes of the approach application

4.1. Partly analysis of the Learning Management Space (LMS)

As an example of implementing EEE principle in the real-life education process, National Research University[‡] “Higher School of Economics” (HSE) has introduced Learning Management System (LMS). Its major objective is to improve the quality of didactical and informational maintenance of the educational process both for the students and tutors, as well as for the department management. Implementation of this educational instrument means the students’ active involvement in the educational process, stimulating constant student-tutor interaction, both on- and off-line. When running LMS, a user’s authentication is essential. A personal set of courses with different access levels is drawn up for each user. LMS provides integration with the unified schedule forming system based on the current study programs, lists of tutors and student, university layout, as well as a student’s status (the system includes four such statuses or modules: matriculant, university student, graduate student, post-graduate student). The system automates HSE’s interaction with its major client – a student – throughout their whole university life and after graduating. The platform provides vast opportunities for collecting and analyzing information, effective management, conducting and control of the study process. Based on the universalism principle, LMS allows the following to the tutors: providing the courses materials (storing files, videos, podcasts etc.); managing students’ activities for the discipline and checking their performance (running assessment register, checking their projects); using various communication means for the educational purposes (forums, polls). For a student, LMS is becoming more and more important with each step in their educational process. Besides downloading courses materials from EEE, students are also granted access to corporate students’ e-mail, on-lone credits records and assessment register for each course, providing them with up-to-date information of their current performance and final marks. As elements contributing to individualizing a student’s study pathway, we can point out their ability to choose the courses from the elective options. It is supposed, that the students choose their options with the objective of forming and enhancing their major discipline competences. When applying for a course, a student accesses the discipline’s page via his/her personal login in LMS. Despite its containing a vast range of tools and components, we cannot claim that currently LMS is an EEE which can provide for an individual study pathway. It is possible that implementing individualistic and competence-based approach, introducing a more “sensitive” interface, purposeful introduction and synchronization of student-tutor interaction, integrating users’ social network profiles and RSS preferences, sending data to the mobile gadgets and other options would contribute to further introducing this system as an important part of the educational process.

4.2. Some methods and techniques of interactive didactic support for learners in the virtual learning environment. The possibility of building a cultural-specific educational strategy

So, how is it possible to determine the skills, competencies and human predisposition of the students, especially in the case where the students themselves do not have a clear idea about them? Most simple ways of the detection

[‡] www.hse.ru

without the participation of the individual in the process are including the aggregation and analysis of information about the individual from the places from his/her educational background and analysis of the review of the individual made by his/her teachers and mentors. As for methods of information collection with the individual present, the simplest and most obvious would be to ask a student to choose competencies and skills from a pre-defined list. In addition, there is an option to implement more complicated method, in which manual input of the student would be analyzed and the system then would try to determine the existence of a particular skill or competency groups, and if that has failed, the system would attempt to determine competency group to which input can be attributed. To solve the latter problem an implementation of an intelligent computer agent would be a good choice, as this would help identify trends in different areas of science and business, and expand the knowledge base of the system. Moreover, there is another option that would be the most difficult to implement. An intelligent agent system could be used for a dialogue with the student in order to identify his skills and aptitudes. This method makes it possible to reveal unexpected competence of the student and suggest appropriate ways for further development in different specialties, of which he/she did not know or were not considered that particular specialties for some reasons⁵.

It should be noted that the problem could be greatly simplified by using archetypes. For example, different students will respond in different ways to the question of how you see yourself in 2 years, 5 years or 10 years. They will name different vacancies, social status, physical or spiritual benefits, but most individuals will seek a small number of very similar objectives, allowing the system to group goals by their nature, constructing the archetypes. There is an example of "Pareto" principle in action - 80% of students choose objectives included in 20% of all responses.

Consider the possible competencies required for certification as a "programmer": while basic knowledge about the structure of the computer and coding skills would be enough to qualify for first level, more advanced levels may require analytical and mathematical competence from the candidate, in addition to a higher level of mastery of the skills from the first certificate.

Generally, the whole system can be represented as a set of:

- Interface for interaction with the students for entering their skills and their professional goals;
- Database that store records containing the aggregated information about vacancies and certificates with standardized requirements for the competencies;
- Agent in charge of the matching students with learning and other opportunities from the data warehouse, trying to maximize effective use of the skills of the student while taking into account their preferences, in other words, the task of mathematical optimization.

We are also interested in the existing ways of adaptation and customization existing educational content and interface for personal and cultural identity of the learner with the help of semantic technologies. A number of researchers working in this direction. In our opinion, in the adaptation of content under KKPL the following characteristics of the student are to be considered: the peculiarities of working with information of a particular student, the specifics of decision-making, a inclination to creative ways to solve problems, attitude taken towards time and society. Characteristic of perception, attitude towards the external environment and peculiarities of communication should considered during the process of adaptation of the interface. Our goal - to create a "smart electronic environment" with cultural intelligence.

Cultural cognitive profile of individual determined at the start would be used to customize the educational activities, tasks, tests and feedback. We assume that difficulties caused by the distance form of the educational process could be overcome if there will be a cross-cultural competency of subjects of pedagogical process and synchronization of the activities. In fact, consideration of the specifics of a certain cultural-cognitive profile of a learner and as a consequence, the nature of its educational activities will make it possible to meet the expectations of students and make the learning process more effective. We believe that to create a smart EEE there are two things to concentrate attention on: the screening and right presentation of educational content tailored for a certain competence profile and screening of options of interface, text and illustrations (including pages of information resource).

Every function, from evaluation of cultural settings of users to generating pages for them could be automated.

Each course can be graded for a number of indicators in the first stage; the students who have received high marks in this subject could conduct assessment. Due to this the student will be offered the most appropriate courses

from within his personal study pathway, and if he/she decides to choose a subject that is not recommended for him/her, the system itself will determine and point out to the student the difficulties that could be encountered during the study of that subject. Educational materials from the various subjects could be assessed for a certain student in a similar way. Thus, the learning process would be held in a manner most appropriate to the individual characteristics of information handling of each student. It is also worth noting that in this way not only internal courses and subjects can be assessed but also external ones, and provide recommendations for the development of the student's competence profile not only from courses available internally, but also from available external ones. External courses should be selected on the basis of the possibility of certification for held skills or exploration of ways to improve knowledge base in the areas to which the student is apt. Such advisory service should be based on regular analysis of trends in development of a certain profile.

A similar evaluation system can be used with interface objects. This will allow one to focus on certain elements, while moving others to the background, change the appearance of various elements or hide unwanted items, displaying only the necessary ones. Using this system will be the most logical way to adapt content to the interface, manage student's attention and to make site navigation intuitive.

5. Conclusion

The learning process in the internet environment often incorporates self-study and often the role of the tutor is taken by electronic environment itself. Due to this, it would be interesting to speculate how the EEE with "cultural intelligence" would work. However, the criteria by which cultural cognitive profile of the student would be formed are to be specified.

The developed cultural intelligence of personal study pathway, in our opinion, will make it possible to determine the cultural cognitive profile of a personality to pick an adequate communication strategy, and in the case of educational communication - individual educational strategy with adequate methods and learning content. It should be noted in the future that it is important to model labor market of specialists according to current demand. Therefore, the creation a system of courses of a certain curriculum should be focused on demand of labor market and thus build a strategy to attract bachelors or masters with particular goals. It is necessary to involve course specialists in the system's support, who will analyze demand for a certain curriculum and recommend amendments to it (if required) according to the forecasts of demand in that and related fields. Moreover, in the system there should be an option to involve Methodists and labor market specialists in the process of forming educational space.

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