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The Methods of Cognitonics as the Basis for Designing Intelligent Tutoring Systems Developing Emotional Intelligence of the Learners

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ABSTRACT

The constructive core of cognitonics, or the science about the human being in the digital world, includes the system of the methods of emotional-imaginative teaching (the EIT-system). This system is aimed at systematic development of emotional intelligence (personal competence and social competence), reasoning skills, sound creativity, language skills, and communication culture at the lessons of language (mother tongue and second language), literature and poetry in two languages (on the example of Russian and English), symbolic languages of painting, sculpture, garden-park art, classic dance. The goal of this paper is revealing to the designers of intelligent tutoring systems (ITSs) the broad prospects of constructing a new generation of ITSs opened by the EIT-system. The principal peculiarities of the discussed new generation of ITSs are to be: (a) taking into account emotional intelligence of children as the basis for designing ITSs; (b) as a consequence, making much easier for children and adolescents the grasping of the pieces of theoretical materials to be learned; (c) for the majority of the systems belonging to this new class, contributing to early socialization of children.

General Terms

Design, Human Factors, Languages, Theory

Keywords

Emotional intelligence, social competence, cognitonics, creativity development, intelligent tutoring system, early socialization of children, theory of dynamic conceptual mappings, system of emotional-imaginative teaching, cognitive engagement

1. INTRODUCTION

During last decade, information society in many countries has been transforming into knowledge society (KS), or smart society. Its main distinguished features are effective knowledge processing, generation of new knowledge, establishing the links between remote knowledge fields, the possession by the specialists in various spheres of creating thinking and the ability of integrating information from numerous dispersed sources.

One of the terms being most popular in the sphere of education is smart learning (SmL). At the first sight, it may seem that SmL is a new stage of education satisfying the demands of KS. However, in fact this term is interpreted in the scientific literature much more narrowly: as learning with broad use of mobile devices: tablet computers, androids, etc. This definition reflects the focus on technical means of learning. There are reasons to believe that the dominant part of the scholars don’t notice the fundamental problem of perfecting, improving the principles of teaching and learning.

We suggest here a much broader definition of SmL, taking into account the significance of basing educational methods on emotional intelligence (EI) and of supporting and developing EI of the learners (see [11]). We believe that SmL is a collection of theoretical ideas and practical methods of teaching and learning developed by smart specialists in education theory, information and communication technologies, mathematics, humanities, arts, and many adjacent fields for creating cognitive-cultural and technical preconditions of up-bringing young generation being personally and professionally successful in smart society.

The analysis of scientific literature shows that a high proportion of elementary, middle, and high school students encounter considerable difficulties as concerns grasping the main ideas of the pieces of theory to be studied. Let’s consider the main social consequences of this situation.

1. The US Public Health Service prepared in the year 2000 a report on children’s mental health [20]. According to this report, approximately one fifth of children and adolescents experienced problems showing their need for mental health services. One of the main reasons for this need is the intellectual and emotional obstacles on the way of successful learning faced by the school students in conditions of too short time for relaxation and refreshing the brain as a consequence of many-hour interaction with the Internet, in particular, with computer games.
2. Rather often, the breaks of discipline at lessons encountered by the students in the process of grasping the materials to be learned cause the growth of aggressiveness towards the teachers and the classmates with higher grades. The breaks of discipline negatively influence the total learning result of the class. Besides, these breaks and the aggressiveness of some students towards the teacher prevent a considerable part of gifted persons with the abilities of good educator from choosing the profession of teacher for himself/herself.

3. The negative consequences of students' aggressive attitude towards their classmates may be very severe (posting in social networks false information about a classmate, false erotic pictures, etc.) and even tragic in cases of cyber bullying [21].
4. In many cases, the attacks of young hackers against socially important technical systems may be explained as a result of expressing the aggressiveness. The intelligent power of applied computer systems is being permanently increased. That is why the negative consequences of the hackers' attacks promise to be increasing too. Taking this dangerous tendency into account, and, besides, the aggressiveness of some students towards their classmates and the teachers, a socially very significant task is to find the ways of making easier for the students the grasping of the pieces of theory to be learned (there are reasons to believe that, very often, the experience of success in the process of learning eliminates the student's aggressiveness).
5. In KS, many countries encounter the problem of insufficiently developed social lifts. The following scientific fact says about the high significance of solving this problem: in different strata of people living in one country, various gifts are distributed approximately in the same way. That is why it would be important to have the situation when the adolescents from different social-economic strata possessing the gifts being crucial for a certain socially significant profession (a medicine, a lawyer, etc.) would enter a university for mastering this profession. Unfortunately, in many countries the real situation is quite opposite. E.g., it applies to UK. As it is shown in [16], the Organisation for Economic Co-operation and Development (OECD) describes the United Kingdom's troubling social mobility problems: more than 50% of youngsters will grow up to have the same salary as their father [18]. The Sutton Trust[19] shows that 53% of the UK's most influential people were independently educated, including 24% of university vice-chancellors, 32% of Members of Parliament, 51% of medical consultants, 54% of top journalists, 70% of High Court judges when only 7% of the UK population are.

During last twenty years, the intelligent tutoring systems (ITSs) have been broadly used throughout the world for helping children and adolescents to grasp theoretical materials. The big subclasses of ITSs help to study (a) second language (SL), (b) mathematics. However, one has been able to find in the literature only separate examples of the systems oriented at developing the personality of the learners. In particular, the interactive multimedia courseware package CITRA is a tool for moral values education using traditional Malay oral narratives [17]. Two collaborative videogames described in [1, 2] not only develop mathematical and language skills of the eight – ten year old children in Mexico but also support and develop in Mexican children the skill of effective collaboration in a team, hence develop social competence.

Our paper [11] introduces a new learning model (LM) called Student-Self Oriented LM (SSOL-model). Its principal distinguished feature is basing on EI and developing EI of the learners. We believe that the SSOL-model may be interpreted as a paradigm for education in KS, i.e., as a paradigm of SmL in the expanded sense of this term. The SSOL-model has at least one successful implementation - the System of Emotional-Imaginative Teaching (the EIT-system), it belongs to the constructive core of cognitonics, or the science about the human being in the digital world (see [7-10]).

The aim of this paper is revealing to the designers of ITSs the broad prospects of constructing a new generation of ITSs opened by cognitonics. More exactly, these prospects are opened by the EIT-system [3-10, 12-15] (see also next section). The principal peculiarities of the discussed new generation of ITSs are to be as follows: (a) taking into account EI of children as the basis for designing ITSs; (b) as a consequence, making much easier for children and adolescents the grasping of the pieces of theoretical materials to be learned; (c) for the majority of the systems belonging to this new class, contributing to early socialization of children.

The structure of this paper is as follows. Section 2 sets forth a rationale for creating the foundations of cognitonics. Section 3 sets forth a script (a collection of instructions) of designing an ITS contributing to the socialization of young children. The system is based on using the world known fairy-tale "Sleeping Beauty". Section 4 indicates the significance of using in the ITSs the vocabulary and images extracted from young children's speech. Section 5 outlines the possible directions of future research.

2. THE RATIONALE FOR FOUNDING A NEW SCIENTIFIC DISCIPLINE – COGNITONICS

In early 1990s we started a study aimed at finding more effective ways of teaching and learning due to systemic basing on young learners' personal experience, including emotional experience accumulated, in particular, during the breakfasts and lunches, the walks in gardens and parks and along a river, while visiting school and theatres, playing various games, sport activities, etc.

Our main motive was the feeling that educational potential of young learners (5 - 7 years old) is much higher than it was broadly accepted to believe. As a key to more effective realization of this potential, we saw the ways of establishing a correspondence between a piece of material to be studied and a certain fragment of the learner's conceptual picture of the world. We called such correspondences *dynamic conceptual mappings* [4].

In three - four years, we obtained several scientific and practical results of high social significance, and these results stood apart from the principal trends in education of the 1990s and early 2000s. It was done due to our original *Theory of Dynamic Conceptual Mappings* (*the DCM-theory*) [4-6, 14, 15] and due to the EIT-system, based on the DCM-theory.

The EIT-system is composed by (a) several complex methods combing teaching/learning with the development of the student's personality and (b) an original program of extra-scholastic humanitarian education covering 12 years of continuous studies, where the starting age is five – six – seven years. The system is aimed at systematic development of EI (personal competence and social competence), reasoning skills, sound creativity, language skills, and communication culture at the lessons of language (mother tongue and SL), literature and poetry in two languages (on the example of Russian and English), symbolic languages of painting, sculpture, garden-park art, classic dance. We do have accumulated the 27-year-long successful experience of using the EIT-system in extra-scholastic education in Moscow, Russia [3-6, 8, 12-15].

We mean here, first of all, the following four scientific and educational results that stood apart from the principal trends in education of the 1990s and early 2000s:

1. An original and effective method of supporting and developing figurative thinking of five-six-seven year old children was proposed. Its essence is teaching young students to decode and to compose metaphors. This method may be interpreted as the foundation of an original, many-staged method of developing creative thinking of young children and adolescents and realizing their Thought-Producing Self (the same mechanism does function in case of both foreign language and mother tongue) [3, 6, 7, 15].
2. In the 1990s and 2000s, according to the generally accepted methods of learning SL by young children (five - seven year old), young learners were taught short poems, songs, and the usage of fixed phrases in standard communication situations. They didn't generate speech from lexical units. Our original approach based on EI of children enabled us to teach young children to read complex texts in English (fairy-tales) with understanding and to generate speech while discussing various situations. The speech of children demonstrated the command of constructing sentences in SL (English) in Present Simple and Past Simple tenses and building questions in Present Simple [4-6, 12-14].
3. A discovery: the consciousness of five-six-year old children demands a very rich language for representing the emotions from the pictures of nature [6, 8].
4. One of the most precious distinguishing features of the EIT-system is no problem with discipline at lessons. This applies both to the lessons with five-six-year old and seventeen-year old students. This phenomenon is a consequence of highest cognitive engagement at lessons due to the basing on EI of the learners [10].

In early 2000s, we realized that it is possible and desirable to do much more for the development of the child's personality (reasoning skills and EI, including social competence) than it is broadly accepted to do throughout the world. This conclusion was drawn in the context of numerous observed negative implications of the Internet's stormy progress and the globalization process underpinned by it.

After thoroughly thinking over this situation, we came to the conclusion that it is necessary to create a new scientific discipline for combining the efforts of the scholars throughout the world for compensating negative implications for the personality development of the Internet's stormy expansion and for creating cognitive-cultural preconditions of successful personality's development. We suggested to call this new discipline "cognitonics" [7]. Later we interpreted cognitonics as the science about the human being in the digital world.

From the standpoint of educational practice, cognitonics proposes an answer to the following question: what precious ideas and images accumulated by the mankind, at what age, and in what a way are to be inscribed into the world's conceptual picture of a person in order to harmonize his/her intellectual and spiritually-coloured emotional development and to contribute to the successful development of national cultures and national languages?

Cognitonics formulates a new, large-scale goal for the software industry and Web science: to develop a new generation of culture-oriented computer programs and online courses (in the collaboration with educators, linguists, art historians, psychologists) - the computer programs and online courses intended for supporting and developing positively-oriented creativity, EI, the appreciation of the roots of the national cultures, the awareness of the integrity of the cultural space in the information and smart society, and for supporting and developing symbolic information processing and linguistic skills, associative and reasoning abilities of children and university students. In October 2009, 2011, 2013, 2015, four international scientific conferences on cognitonics (Cognit-2009 – Cognit-2015) took place under the framework of the international scientific multi-conferences "Information Society" (IS-2009, IS-2011, IS-2013, and IS-2015, Slovenia, Ljubljana, Jozef Stefan Institute). The access to the proceedings of the conferences Cognit-2009 – Cognit-2015 is open, see https://is.ijs.si/proceedings.php. A part of cognitonics-based scientific and practical results is presented in the Second Edition of the International Encyclopedia of Social and Behavioral Studies [3].

3. A SCRIPT OF AN INTELLIGENT TUTORING SYSTEM CONTRIBUTING TO EARLY SOCIALIZATION OF THE LEARNERS

The analysis shows that the methods of cognitonics open broad prospects for the development of a new generation of ITSs. Their principal distinguished features should be orientation at culture, at developing EI of the learners.

New, culture-oriented scripts under the framework of cognitonics may be divided into three main groups.

Group 1: Socialization-oriented scripts.

Group 2. Improvement of the language (mother tongue and SL) as a tool of thinking in order to oppose the phenomenon of poor language and, as a consequence, poor cognitive process, that is, an underdeveloped tool of constructing social reality.

Group 3. The scripts aimed at demonstrating the possibilities of expressing the same idea by means of different languages, for instance, by means of natural language and the language of painting. The goal is the development of the ability to see something extraordinary in an ordinary thing or situation, to find a new look at an object of interest and to make a discovery, to develop the ability of processing serendipitous information.

Let's consider a script of a culture-oriented ITS based on the idea of social conventions. The literary source of this script is the fairy-tale "Sleeping Beauty". The script is associated with two aims. The first aim is to explain how it is possible for the student to escape in the life the meeting with the 13th fairy. It means not to make a person act in a provocative way. The reason is that such kind of behaviour would make harm both to an initiator and to a person. In case of the considered fairy-tale, a fairy turned into a witch, because she could not cope with emotions and gave way to hatred. The second aim is to develop the Ecological Self of the student.

Instruction 1 for the designers.

Construct a dwelling (a hut, a castle, a palace, a cottage, etc.) appropriate for a King and a Queen and for the 13th fairy.

Put the dwelling into appropriate surrounding (garden, park, edge of the forest, etc.).

Choose the interior revealing the characters of the story.

Choose the time of the day, the season. Dress the characters up and choose some occupations for them.

Instruction 2.

According to the logic of Instruction 1, create a big album containing the photos of the characters in different situations. One part of the photos adequately illustrates the life of the personages.

Another part falsely illustrates the actions of the personages (in such cases an action or situation contradicts the properties of the character).

Motivate the students to select the photos for the album of each character. The aim of this subsystem of the ITS is to develop the ability of the student to correctly associate the actions of a character with the essence of this character.

Instruction 3.

Create a subsystem motivating students to construct a dynamic picture showing the extensive preparations in the Kingdom for the Christening Party.

Step 1: The construction of a picture showing all kinds of the living beings (in particular, the carpenter, the animals, and the birds) in the Royal Park.

Step 2: Ask the student to select the living beings for active preparation for the Christening Party.

Step 3: For each considered living being, select one of four-five actions.

Example. It is possible that for the birds a student will select the action "sing the songs".

Instruction 4.

In general terms, the task is to realize the step explicating the essence of social responsibility. The details of this step are as follows.

The King should be sure that every guest has received the invitation and has accepted the invitation. In order to be sure, the King is to receive a confirmation from every guest that the guest has received and has accepted the invitation. The violation of the rule leads to misunderstanding. In our case, the 13th fairy didn't receive the invitation, though the King had sent an invitation, and regarded the lack of invitation as a mark of disrespect on his part.

Instruction 5. Explain to children how the violation of etiquette will mislead them. Preventing a violation of etiquette means not to make a person act in a provocative way. The reason is that such kind of behaviour would make harm both to an initiator and to a person. In case of the considered fairy-tale, the fairy turned into a witch, because she could not cope with emotions and gave way to hatred. Consider possible examples.

Example 1. One meets a classmate but doesn't greet him/her. It may lead to offense.

Example 2. One may take a pencil of a classmate without the permission. The classmate may become cross with him/her.

Example 3. One may eat a cake without expressing his/her gratitude to a classmate. The classmate may think that he/she is not polite.

Example 4. When he/she does something wrong and doesn't apologize, then the classmate may think that he/she is rude with him/her.

Example 5. When a classmate brings a mouse, though he/she knows that the girl is afraid of mice, it means that he/she is selfish, because he/she doesn't take into account the peculiarities of the girl.

Instruction 6. The essence of this step is to construct the chains revealing the behaviour of the character of the book who is thinking and acting in terms of public good.

Example 1. The 12th fairy was attentive and ready to help, she made up the situation and tried to make not only the princess but the whole kingdom fall asleep. The motive of the fairy was not to make the princess lonely when she woke.

Example 2. The people of the kingdom were ready to help, and they brought their spindles to the square to make a fire. They were ready to sacrifice the necessary things and not to have new clothes, because they would not have the spindles to spin.

Instruction 7.

Preliminary stage. Ask five-six-seven-year-old children being acquainted with the fairytale "Sleeping Beauty" to describe the preparations in the Kingdom to the birth of a princess. Construct a collection containing all proposed creatures and their actions of the kind.

Main stage. Ask children to select the creatures and their preparations to the birth of a princess.

4. CHILDREN'S SPEECH AS A SOURCE OF VOCABULARY AND IMAGES FOR THE DESIGNERS OF TUTORING SYSTEMS

The inner world's picture of young children is very different from the picture of adults. Young children have a vivid imagination, and they easily go from the reality into the world of fantasy. That is why it is very important for the designers of ITSs to use in the computer systems the vocabulary and images extracted from children's examples collected at the preliminary stage of developing a system.

We have collected, in particular, the following examples given by children:

Preparation of gifts

(1) The gardener prepares fountains and flower beds; (2) the carpenter makes the cradle shaped like (a) a swan, (b) dolphin which always rescues, (c) see-shell in which the princess will be like a pearl, (d) a flower which opens its petals at dawn; (3) the beasts prepare (a) milk taken from forest plants, (b) pick up glow-worms; the birds sing songs; the kittens are purring a lullaby; the baby-squirrels have picked up nuts; the mother-dogs are knitting mittens; the mother-squirrels are sewing the dresses for the dolls of the princess.

Preparation in the palace

(1) The birds are bringing in the beaks the field flowers; (2) the chipmunks are bringing the baskets with drops of dew in order to water field flowers; (3) in the evening the star peeps through the curtain to light the room; (4) the little angel descends in order to fill the nursery with kind dreams and to kiss the princess good night.

5. POSSIBLE DIRECTIONS OF FUTURE STUDIES

The considered script allows us to get an initial impression about the possibilities of using the methods of emotional-imaginative teaching as the basis for developing ITSs of a new generation. This script may be compared with a single piece of a big, complicated mosaic picture to be created. The EIT-system provides original effective methods for designing ITSs solving the following tasks:

- developing imagination, creativity by means of teaching to decode metaphors and invent metaphors;
- contributing to early socialization of the learners on the example of etiquette as a social agreement (etiquette makes the behaviour of the humans predictable, it is very important for understanding

each other and in order not to heart the feelings of people);
- making thrilling the mastering of SL grammar (on the example of English);
- teaching the learners to integrate information dispersed in various sources and to establish time-causal relationships between the extracted facts;
- revealing cross-culture differences for avoiding misunderstanding during communication.

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