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Transporta un sakaru institūts

MŪSDIENU IZGLĪTĪBAS PROBLĒMAS

Starpaugstskolu Zinātniski praktiskā
un mācību metodiskā konference

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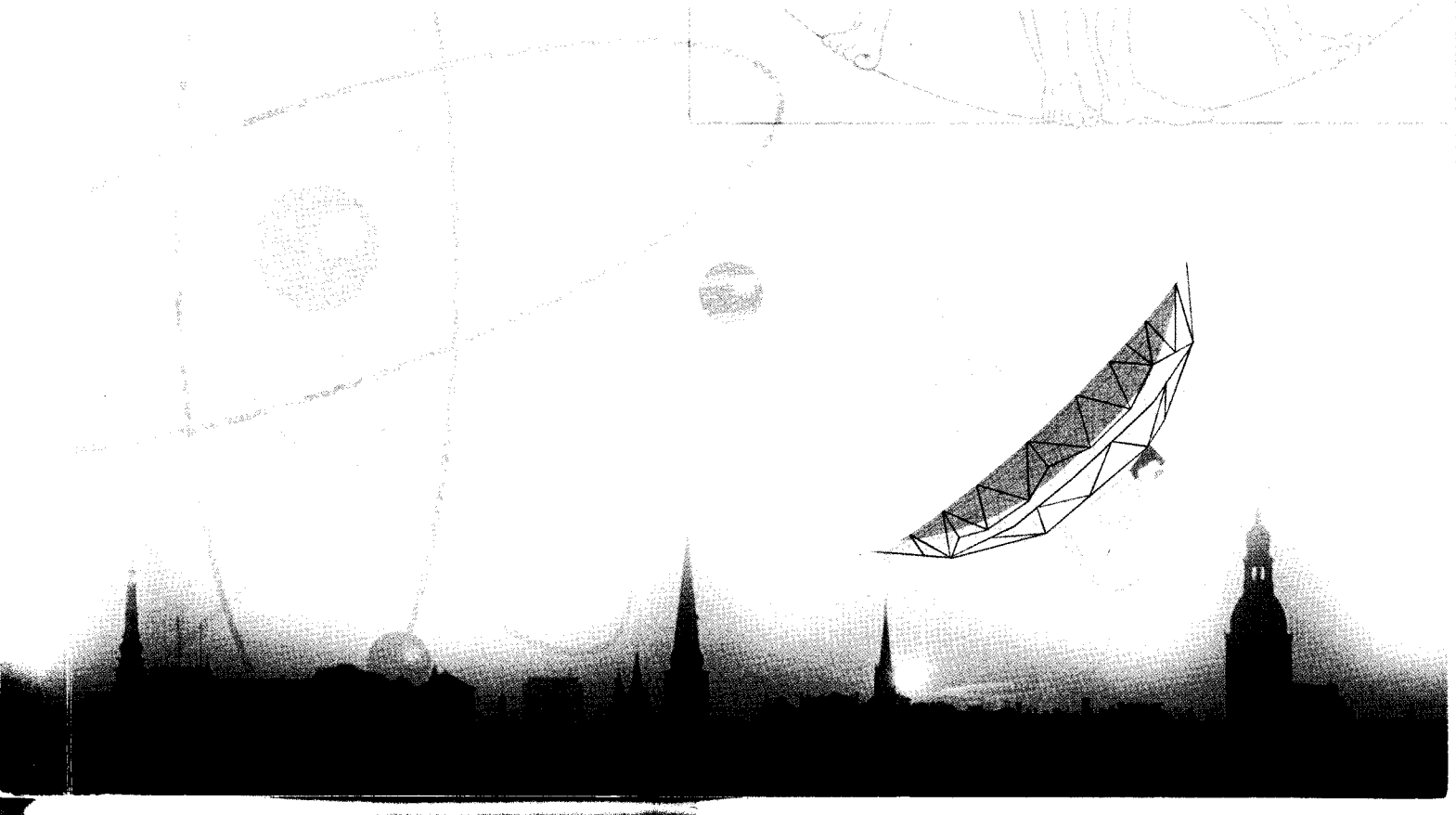

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ZINĀŠANU VĒRTĒŠANA UN PAŠVĒRTĒŠANA PROCESORIENTĒTĀS STUDIJĀS, IZMANTOJOT UZ JĒDZIENU TĪKLIEM BALSTĪTU INTELEKTUĀLU SISTĒMU

KNOWLEDGE ASSESSMENT AND SELF-ASSESSMENT IN THE PROCESS-ORIENTED LEARNING, USING INTELLIGENT SYSTEM BASED ON CONCEPT MAPS

ОЦЕНИВАНИЕ И САМООЦЕНИВАНИЕ ЗНАНИЙ В ОРИЕНТИРОВАННОМ НА ПРОЦЕСС ОБУЧЕНИИ, ИСПОЛЬЗУЯ ОСНОВАННУЮ НА КАРТАХ ПОНЯТИЙ ИНТЕЛЛЕКТУАЛЬНУЮ СИСТЕМУ

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Whereas in our past we believed that an educated and civilised person is the one who is able to possess and recall large quantities of knowledge, now we think that it is far more valuable to be able to process information and build new knowledge. More specifically, such skills as data gathering and analysis, information processing, applying knowledge in new situations, problem solving and regulating our own intellectual processes are in the centre of high quality education and learning.

When the qualitative aspect of learning is emphasised it has fundamental consequences not only to curricula and the ways in which studies are organised, but also to what the students are expected to learn in different subjects and how these desired outcomes are about to be assessed. Assessment becomes as if a tool of knowledge management and remediation instead of an instrument of knowledge control [1]. If we accept that assessment in any case will have a steering effect on teaching and learning, we should also expect that high-quality assessment that emphasises learning as understanding of knowledge and development of skills and habits of mind will have a positive impact on quality of learning.

There are three issues that have emerged when the quality aspect of teaching and learning has become more important:

- Evaluation of education in general and assessment of students' learning outcomes in particular should be based on a clear consensus of what is expected from schools and students in terms of performance and learning. Learning or performance standards do not provide an adequate basis for measuring the quality. For example, if the curriculum does not clearly indicate what the students in any given stage should know and be able to do, assessment criteria are missing.
- A student is the ultimate user of assessment information that is elicited in order to improve learning. One of the major challenges is how to report students' progress to themselves.
- There is a need for considerable improvement in assessment technology and methodology. There is a growing consensus among the education specialists that new assessments are needed to measure a broader range of abilities of students and to give teachers better information about students' progress and achievement. Such techniques as computer-adaptive testing, large-scale testing, classroom assessment and performance assessment may be combined into multiple method that will open up new ways of assessing complex cognitive activities. Contemporary assessment systems should integrate several methods, including self-assessment of students.

Furthermore, there is a need to develop specific value-added approaches to track student achievement more precisely. Value-added methodology measures the growth in achievement of an individual student from one point in time to another. Thus, in order to provide qualitative study it is necessary to assess not only the result of the learning process, but the process itself. When assessment is made at the end of the learning course, it is impossible to determine how the learner's cognitive processes have developed, at what learning stage he/she has met difficulties which as a result have led to incomplete or insufficient development of knowledge and skills. It is also already late to start any remedial actions. Regular assessment of the learning process allows analyzing suitability and quality of learning content and chosen teaching methods and to change them for promotion of the learning course towards achievement of desirable characteristics of students' knowledge.

Students' ability to apply knowledge in real-life situations becomes more valued as a goal of education. As a consequence, self-assessment and other reflective practices will become accepted as elements of assessment methodology. Self-assessment has an important role in the learning process for many reasons:

- as a result of self-assessment a learner comes to conclusion about his/her abilities, skills and features of character;
- knowledge self-assessment allows to activate a learner in the learning process, disciplines and motivates him/her, thus, promoting more realized approach to the learning process and performance of tasks;
- knowledge self-assessment activates cognitive activity of a learner, making him/her to think about the acquired knowledge and skills and to ask itself questions where and why he/she has made mistakes in any task;
- regular knowledge self-assessment allows preparing for final assessment such as an exam;
- providing opportunities of knowledge self-assessment, a teacher can inform about his/her expectations from the learning process as well as what a learner should know in order to determine that he/she has mastered the teaching material.

However, knowledge self-assessment often passes unnoticeably for the teacher, when the learner performs tasks, compares his/her activity to activity of other learners or discusses learning-related questions with classmates. For this reason the learner in knowledge self-assessment often uses other criteria, instead of those that the teacher uses for learner's knowledge assessment.

The teacher does not usually put process oriented knowledge assessment into practice as it demands additional time and cost. For the same reason knowledge self-assessment often is ignored at all. However, the use of computerized tools can help to solve these problems.

Rapid growth of possibilities given by information and communication technologies and computers, in particular, has provided potential for much more sophisticated support for teaching and learning process. A lot of work has been done and a plethora of terms appeared including such terms as computer-based learning, distance learning, e-learning, Internet-based learning, online learning, and Web-based learning, for which according to [2] an umbrella term is technology-based learning. However, regardless the significant achievements and development of great number of rather effective technology-based learning systems give students the possibilities to learn in their own speed, at any time and place, the analysis of the state of the art clearly shows that, in general, the main disadvantage of the known systems is their insufficient flexibility. Systems and environments developed till now, in fact with only one exception, have not been designed to be adaptive enough to student individual demands towards feedback given by the system in each particular and different situation, as well as towards teacher wishes to have much more advanced support for knowledge assessment.

New hopes for better solutions emerged around three decades ago when the first intelligent tutoring systems [3] appeared. Such kind of systems provides the most suitable learning for learner's knowledge level and characteristics. They use principles of artificial intelligence and pedagogy in their architecture and operation, and stores knowledge about problem domain, learners and teaching strategies.

Generally, intelligent tutoring systems have many tasks: monitoring of learner's actions and responding to them appropriately, selection and presentation of learning material, ensuring of feedback and help, adaptation of teaching strategy, and assessment of learner's knowledge level [4]. However, analysis of available publications reveals that such issues as continuous assessment of learner's knowledge and skills, as well as more sophisticated tools for support of teaching and learning process to satisfy the growing demands of a teacher and a learner have not met enough attention from the developers of intelligent tutoring systems.

The prototype of the intelligent system based on concept maps for student knowledge self-assessment and assessment from the teacher side at each stage of the learning course has been developed at the Department of System Theory and Design of Riga Technical University. The system gives the teacher an

opportunity to use knowledge assessment results for analysis of quality and suitability of learning material, to choose methods of teaching in order to change them timely, and to promote a learning course towards achievement of desirable learning outcomes.

Concept maps – a visual representation of concepts and their relationships within particular domain using graphs – assist a teacher in tracking of student's understanding of teaching material and of student's knowledge organization, and provide an opportunity for a student to make sure that relationships between studied concepts are correctly understood [5]. An example of a concept map for the learning course "SQL Fundamentals" is given in [6].

The structure of a teacher's concept map prepared in advance can be used at the end of each stage of a learning course as a tool for student's knowledge assessment and self-assessment. The developed system supports such scenario. The teacher divides a learning course into several stages. The notion of a stage is not strictly defined and it can be any logically complete part of a learning course, for example, a chapter or a topic. Using the developed intelligent system the teacher prepares a corresponding concept map for each stage of the learning course, specifies one or several initial concepts and publication date of the map (date when a concept map will become accessible for learners), and makes knowledge assessment at the end of each stage. It is important to note how a concept map for each stage is formed. Concepts taught to students at the first stage of the learning course together with relationships between them form the first concept map of the learning course. At the second stage the students acquire new concepts. The teacher adds these concepts to the concept map of the first stage, but doesn't change the relationships among already existing concepts. Thus, a concept map of each stage is not anything else as extension of a concept map of the previous stage. The concept map of the last stage displays all concepts in the learning course and relationships between them. During knowledge assessment the students get a structure of a concept map which corresponds to the learning stage. At the first stage it is an empty structure with very few initial concepts defined by the teacher. In the subsequent stages new concepts are included in addition with those, which the learner already has correctly inserted during the previous stages. In both cases the set of concepts which should be inserted into the structure of the concept map is given to the learner. After finishing the concept map, a learner submits his/her solution and the system compares the concept map of the teacher and the student-completed concept map, giving feedback about correctness of his/her solution.

The developed system consists of the three major parts. The teacher's module includes interface for concept map design and tools for viewing concept maps filled by the students and results of comparison with the map of the teacher.

The learner's module provides tools for filling concept maps and viewing of the feedback after their comparison with teacher's concept maps.

The third module of the system is used by the system administrator, which is responsible for the system maintenance.

The primary purpose of the system is to carry out comparison of the concept maps of the teacher and the student and to give a feedback to them. The most important feature of the system is an intelligent algorithm for concept map analysis, which distinguishes different variations of the correct filling of the concept map [7]. It is based on assumption, that the fact that the learner understands presence of relationships between concepts has the primary value, while the place of concepts within the structure of the concept map is the secondary thing.

The system has been developed using the following tools: Borland JBuilder 9.0., JGraph, PostgreSQL DBMS 8.0.3. and JDBC drivers for PostgreSQL. Thus, the system is a Web-based application and it can be used from any remote place where there is an Internet connection.

Furthermore, the system is a multi-agent system, which consists of an intelligent agent for assessment of learners' current knowledge level and a group of human agents, i.e. learners who are communicating with this agent. The intelligent assessment agent is a core of the system as it is responsible for the abovementioned comparison of teacher's and student's concept maps. It is made up of communication, knowledge evaluation, interaction registering and expert agents at the moment.

A number of reasons affected the choice of agent technology. Agents provide simplicity of analysis, implementation and maintenance of systems and also improve such aspects of their performance as reliability, computational efficiency, robustness, responsiveness [8], etc. They have such properties as autonomy, reactivity, proactivity, social capability, capabilities of learning and reasoning, adaptability, and mobility. Agents are able to act in complex dynamic environments performing tasks entrusted to them [4]. All the abovementioned properties are desirable for intelligent tutoring systems, too.

The developed system was tested on four learning courses of social and engineering sciences. In total 74 students were undergone the testing. After testing students were asked to complete a questionnaire. There

are fifteen questions in the questionnaire, seven of them deal with the evaluation of system's performance and eight questions are related to the used approach based on concept maps. As a result sixty three questionnaires have been processed. The analysis of the questionnaires revealed that the students positively evaluated the chosen approach to knowledge assessment, as well as functionality and user interface of the system. They also stated desire to use such assessment technique in the courses that will follow. The specified drawbacks, in their turn, gave new ideas for future work.

The system has a good potential for further evolution. The main directions of future work are related with the deepening of approach to knowledge assessment, improvement of feedback given to the teacher and to the learner, as well as of user interface of the system.

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