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KNOWLEDGE ASSESSMENT SYSTEMS: AN OVERVIEW

ZINĀŠANU VĒRTĒŠANAS SISTĒMU APSKATS

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Computer-assisted assessment, assessment system, student model, intelligent support, adaptivity

1. Introduction

Knowledge assessment is an integral part of the learning process. However, it is a very time and effort consuming activity in the traditional learning process, because it demands from the teacher to prepare assessment tasks or questions, to conduct assessment activities, to check and evaluate students' works, to provide feedback. This is the reason for the development of computer-assisted assessment systems. The mentioned systems are used, on the one hand, to detect students' knowledge and skills, but, on the other hand, to regulate teaching and learning process on the basis of informative and tutoring feedback generated automatically by the system.

The paper presents results of the research which has twofold goals: firstly, to collect and summarize broadly scattered information about computer-assisted assessment systems in one place, and, secondly, to define directions of improvement of a concept map based knowledge assessment system developed at Riga Technical University. The following main results are achieved during the conducted research: advantages and drawbacks of computer-assisted assessment systems are summarized, general architecture of a computer-assisted assessment system is drawn and key factors of successful application of any computer-assisted assessment system are identified. In addition, on the basis of the performed analysis areas of improvement of the concept map based knowledge assessment system are determined.

The paper is organized as follows. Section 2 explains the concept of computer-assisted assessment and describes systems of objective and subjective testing in brief. The advantages and drawbacks of computer-assisted assessment systems are presented in Section 3. Section 4 discusses the general architecture of a computer-assisted assessment system. Section 5 is devoted to the intelligent and adaptive support in computer-assisted assessment systems. The student model used as a basis for the implementation of adaptivity is described in Section 6. Section 7 presents the concept map based knowledge assessment system. The paper ends with Conclusions.

2. Concept of computer-assisted assessment

According to [1] computer-assisted assessment is a common term for the use of computers in assessment of student learning. However, today there is a variety of other widely used terms such as e-assessment, Internet-based assessment, online assessment, Web-based assessment, etc. Actually, all of them mean the same, that is, the application of computers or, more precisely, of a computer-based assessment system to knowledge assessment activities. In [2] the following tasks of computer-assisted assessment systems are mentioned:

- the delivery of assessment tasks and results to students;
- assessments taken in whole or part on computer;
- computer marking of assessments;
- electronic collation and transfer of grades and assessment data;
- clectronic delivery of training and support materials.

Computer-assisted assessment systems can be used for initial, formative and summative assessment. Initial assessment, as a rule, is performed at the beginning of learning process in order to gather diagnostic and prognostic information concerning students' knowledge and skills. Formative assessment is carried out during instruction in order to obtain information about the regulation of teaching and learning process, to identify obstacles that can be found in learning process and to detect topics that need to be reinforced. Summative assessment takes place at the end of learning with aim to determine students' achieved level of knowledge and skills in a given domain [3, 4].

According to [5] the same term "computer-assisted assessment" is defined narrowly and refers to the use of computers in assessment, encompassing delivering, marking and analysis of assignments or examinations, as well as collation and analysis of data gathered from optical mark readers. The definition clearly distinguishes two basic forms of computer-assisted assessment:

- systems, where students submit their works or answers using a computer that further makes their analysis and evaluation;
- optical mark readers, which scan, interpret and evaluate paper forms of tests completed by students through the marking answers on test questions.

The first mentioned basic form of computer-assisted assessment can be divided into systems providing objective testing and systems supporting subjective testing [6]. Systems based on objective tests are the most widespread systems of computer-assisted assessment. They offer the student a set of questions, answers to which are pre-defined [5], in other words, assessment is not subjective, because no judgment has to be made on the correctness of an answer at the time of marking [7]. Thus, in such systems the student is offered a question and he/she inputs an answer. The system compares the entered answer with the answer defined by the teacher and provides feedback to the student. There are different types of questions, but the main ones are the following [3]:

- multiple choice questions (students are asked to select one answer from a list of possible answers);
- multiple response questions (students are asked to select any number of answers from a list of possible answers);
- graphical hotspot (students are asked to select areas of the screen by moving a marker to the required position or filling in a block in a particular position linked to a graphic illustration on a specially designed paper answer sheet);
- text/numerical questions (students are asked to input text or numbers in the particular field using the keyboard).

Computer-assisted objective testing systems vary significantly in their functional complexity. Simple systems act as authoring tools providing the possibility for the teacher to construct questions manually. Complex testing systems are able to create questions automatically on the basis of the dynamically sclected learning content provided by the teacher. Such systems combine various techniques of natural language processing to construct questions. In most cases these systems are also able to process students' answers that are given in a free text form [8, 9].

Systems of subjective testing can assess students' submitted works for content, style, originality, etc. [6], for example, e-rater [10], c-rater [11], Auto-marking [12]. As a rule, they are based on essays and free text responses and use methods of artificial intelligence, especially natural language processing.

3. Advantages and drawbacks of computer-assisted assessment systems

In general, the use of computer-assisted assessment systems provides a number of advantages [3, 6, 13, 14, 15, 16]:

- a wide range of topics can be tested quickly;
- large groups of students can be assessed quickly;
- provision of the potential for frequent assessments and, as consequence, the regular monitoring of the progress of students;
- a variety of media (images, video, audio, etc.) can be included in assessment questions or tasks;
- extensive feedback can be provided to teachers through various diagnostic reports;
- decrease in time needed for supervising and marking of assessments;
- greater flexibility regarding place and time of assessment;
- elimination of any prejudices in relation to students;

- instant feedback to students;
- reduced mistakes in comparison with human marking;
- results can be automatically entered into administration systems.

Despite of all advantages computer-assisted assessment systems have also drawbacks [3]:

- implementation of an assessment system can be costly and time-consuming;
- difficult to reproduce freedom of paper examination e.g. scanning exercises to choose which to make;
- assessors need training in assessment design, IT skills and examinations management;
- students require adequate IT skills and experience of the assessment type;
- good system maintenance is required to avoid downtime during examinations.

Considering objective testing the following advantages can be identified in addition to the already mentioned advantages of computer-assisted assessment systems:

- it is easy enough to define questions, because a wide experience is accumulated in the development of knowledge assessment systems based on objective tests;
- objective testing can be used for initial, formative and summative assessment, as well as for other kinds of assessment, for example, self-assessment.

Moreover, one of the most promising advantages of the application of computer-assisted assessment systems based on objective tests seems to be the possibility of automatic bidirectional translation of questions and answers from one language to other language(-s), as it is implemented in the computer-assisted assessment system Atenea [17]. Thus, it allows an assessment system to be used by students and teachers from different nationalities, because the author of a course simply writes the questions in his/her own language (for example, in Latvian) and the student (for example, an English speaker) receives the question translated automatically into English, writes the answer, and the system automatically translates it into Latvian and compares it against the teacher's answer.

However, systems of objective testing have the following drawbacks:

- objective testing does not allow the student to offer original answers, so there are restrictions on knowledge and skills which can be assessed. According to [7, 16] such systems allow evaluation only of the first four levels in widely accepted in pedagogy Bloom's taxonomy [18], which includes three levels of lower order skills (knowledge, comprehension, and application), and three levels of higher order skills (analysis, synthesis, and evaluation). In [7] this assertion is said to be erroneous, but it is pointed out that designing test questions to assess higher order skills can be time consuming and requires skills and creativity;
- objective testing assesses only factual knowledge instead of student's understanding about their interconnectedness and significance in the learning course;
- objective tests encourage students guessing.

Subjective testing, in turn, provides the following advantages [19, 20]:

- it allows the student to offer original answers and judgments, to demonstrate ability to organize knowledge and express opinions, thus, higher order cognitive skills can be assessed;
- students can display a broader range of knowledge about a particular topic;
- students less likely to guess.

Systems of subjective testing use methods of artificial intelligence, especially natural language processing. This fact is the reason for the main drawbacks of such systems: dependency on a subject and natural language, as well as complex structure and functional mechanisms. Moreover, the use of essays and free text responses for systematic assessment is a questionable issue due to a high cognitive load for students. Other drawbacks are the following [19, 20]: limitations of the extent of content covered by assessment and more subjective assessment due to the taking into account such factors as style and originality of assignments.

4. General architecture of a computer-assisted assessment system

In general, computer-assisted assessment systems are designed to be used by three types of users – an administrator, a course instructor (a teacher) and a student. The administrator updates records of courses, instructors and students and also gives access rights to other two types of users. The course

instructor organizes curriculum, designs tasks and views assessment results. The student takes published tests or performs tasks [21, 22].

The analysis of computer-assisted assessment systems intended both for objective and subjective testing shows that almost each system has its own architecture [23, 24]. From our point of view there are two main reasons for such architectural differences. Firstly, each computer-assisted assessment system has its own behavioral model. Secondly, each developer has its own preferences on dividing system functionality into structural units.

Trying to recap information about available architectures and their similarities a general architectural model of a computer-assisted assessment system has been developed. It is presented in Figure 1.



COMPUTER-ASSISTED ASSESSMENT SYSTEM

Fig. 1. General architecture of a computer-assisted assessment system

The architecture given in Figure 1 incorporates the following structural units:

- 1. Interface (or Interaction) Module. It is responsible for the provision of interaction between a user and the system. The main tasks of this component are the following: to present tasks and feedback, to activate the other modules according to the student's actions, to collect data concerning the student's observable behavior and to update the student model with the newly acquired information. The interface module passes student's solutions to the evaluation module for their evaluation. If the student set some preferences regarding the interface and behavior of the system the interface module also stores these parameters in the student model.
- 2. *Adaptation Module*. It is responsible for the selection of tasks suitable for a particular student taking into account the student's level of knowledge, skills and preferences. Adapted tasks from the adaptation module are passed to the interface module for their presentation to the student.
- 3. *Evaluation (or Diagnostic) Module.* It is responsible for the evaluation of student's solutions and generation of feedback. The mentioned module is the brain of the computer-assisted assessment system because it provides the intelligent solution analysis [25] that is discussed in the next section in detail. Evaluation results are used further mainly to update knowledge level in the student model. Results of each completed task are also passed to the adaptation module for the selection of the next assessment task.
- 4. Domain (or Expert) Knowledge. The content of this structural unit can vary significantly depending on the level of sophistication of a system. Obviously, it stores all information related to assessment activities such as statements of tasks/questions and their possible solutions/answers. However, knowledge concerning assessment goals and outcomes, possible

solutions paths, available feedback forms and content also can be included. Moreover, if a system along with the assessment function supports also the tutoring function, then domain knowledge can incorporate units of learning material that can be revised by a student in case of low results in assessment. Domain knowledge is passed to the adaptation module to adapt assessment tasks to the student needs before assessment takes place, and to the interface module to show the student the correct solutions after assessment is completed.

5. *Student (or Learner) Model.* It stores information about a student such as general information, knowledge level, preferences, etc. The student profile is passed further to the adaptation module to adapt assessment scenario to the student needs.

The adaptation module is depicted by dash line in Figure 1 because this component is an optional and there are systems which do not provide adaptivity to a particular student and, therefore, offer the same assessment scenario for all students regardless their level of knowledge and skills and preferences, i.e., such systems are not able to generate individual assessment plans.

5. Intelligent and adaptive support in computer-assisted assessment systems

The key factor of successful application of any computer-assisted assessment system is the level of its intelligence and adaptivity due to the fact that students have different needs and these differences should also be considered in computer-assisted assessment through the provision of an individualized approach to each student. Otherwise, if a unified assessment style does not match the style of a particular student it can have negative impact on assessment process by leading to worse results [26]. Therefore, in order the assessment process implemented through the use of a computer-assisted assessment system to be effective an intelligent and adaptive approach should be applied.

A system is called to be intelligent if it uses principles and methods of artificial intelligence [25] (such as the processing of natural language, knowledge representation, inference mechanisms and machine learning) in its structure and operation. In turn, adaptivity is defined as the capability of the system to change behavior automatically without a deliberate action on the user's part [27].

According to [25] intelligence is concerned with the intelligent solution analysis and the intelligent problem solving support. Unlike systems which do not incorporate intelligent solution analyzers and, as a result, are capable of telling only whether the student's solution is correct or not, systems performing the intelligent solution analysis can tell what is wrong or incomplete and which missing or incorrect pieces of knowledge may be responsible for the mistake. The intelligent problem solving support concerns the provision of intelligent help during the problem solving process and the end of it. Intelligent help can be given in forms of hints or leading questions relevant to the current situation in problem solving. Its main task is to allow a student to activate his/her thinking processes in order to obtain the correct solution of a task. In turn, tutoring feedback can be directed towards filling in gaps in knowledge simultaneously with the knowledge assessment by providing pieces of relevant learning material or towards facilitation of further direction of learning.

It is possible to conclude that systems of subjective testing are mainly intelligent systems because they perform not only the analysis of text in natural language through the use of corresponding methods of artificial intelligence, but also check matching of the text to criteria corresponding to the content, style, originality and identification of reasons of mismatching. In turn, the greater part of objective testing systems are not intelligent because they do not provide the intelligent solution analysis and the intelligent problem solving support, but typically compare the student's submitted answer with the teacher's predefined answer without the identification of the reasons of the mismatching between the mentioned answers, as well as the provision of very simple feedback (usually defined by the teacher) in form of short sentences pointing out whether the answer is/ is not correct.

In other knowledge assessment systems [8, 26, 28, 29, 30] both previously mentioned terms - the intelligent solution analysis and the intelligent problem solving support - can be closely related. If a system is not able to perform the intelligent solution analysis then no tutoring feedback or individualized help can be generated.

The adaptivity in computer-assisted assessment systems refers mostly to the adaptive presentation of assessment content and means the ability of a system to generate an individual assessment scenario (tasks sequence). If a system is not adaptive then for all students the same assessment scenario is applied. In contrast, an adaptive computer-assisted assessment system [18, 29, 30] provides an individual assessment scenario for each student taking into account student's prior knowledge level, preferences and already given solutions.

Objective testing can be adaptive. In this case the terms "computer adaptive assessment" or "computer adaptive testing" are used. In adaptive testing questions are adjusted to the learner's knowledge level. In most cases the widely known Item Response Theory (IRT) is used to generate an individual assessment scenario. In accordance with IRT selection of the next question depends on answer given to the previous question (-s). The procedure is described in [31] in detail. At the beginning of the assessment the student receives a question of average difficulty. If he/she gives a wrong answer, he/she receives a less difficult question. Otherwise, the student receives a more difficult question. This process continues until the predetermined test termination criteria have been met. In such an approach each student receives a unique set of questions, which allows more accurate determination of his/her achievement level. Thus, students at a low achievement level are not required to respond to questions that are too simple for them.

The intelligent and adaptive support in computer-assisted assessment systems can be achieved by the use of a student model which is discussed in the next section in detail.

6. Use of the student model in computer-assisted assessment systems

Student or learner modelling is related to the task of keeping a record of many aspects of a student. This record is called a student (or a learner) model. The student model reflects specific characteristics of the student and thus it is used as the main source of the adaptive behavior of any computer-assisted assessment system [17, 23, 26, 32].

The information held is the student model is divided into domain dependent information or dynamic information that changes during the assessment process and domain independent information or static information that is relatively constant through the assessment process. Regarding the domain dependent information the student model keeps information about the student's knowledge level, the student's mistakes, the student's behavior during his/her interaction with the system (number of help asked, frequency of mistakes made, time of response, etc.). The domain independent information is the general information about the student such as the username, the profession, student's favorite feedback components and knowledge units (i.e., definition/description, example, image), last time/date the student logged on/off, etc. The student model is dynamically updated during the student's interaction with the system in order to keep track of the student's "current state".

Information about the student can be obtained from different sources:

- from user-filled forms at the initial stage of the use of the system when the student is asked to answer a questionnaire about his/her personal data and preferences; in some cases psychological tests can be applied in order to get information about student's preferred learning style;
- from student observable behavior when he/she works with the course (e.g., pages visited, time spent in each page, navigation path followed, chosen options, etc.);
- from results concerning solving of practical problems and tasks;
- from the observations of the student through the use of different sensors [33, 34, 35].

Thus, the process of the acquisition of information about the student can run in different modes [32]: passive (when the system infers the model of students without explicit help from them), active (when students may be asked questions by the system to assist it) or interactive (when students play an active role in the development and maintenance of their own model).

Student models can be classified according to different factors. The available classifications are summarized in Table 1 [21, 36, 37].

Table 1

Classification factor	Group	Description
1. Openness	1.1. Open	The model is shown to students or instructors. In this way, students may get actively involved in their diagnostic process by looking at how they understand the concepts in the learning
		domain. Besides, educators can be provided with more feedback about their students' knowledge assimilation state and help them to improve it.
	1.1.1. Inspectable	The model is shown to instructors and/or students but they are not allowed to modify it.
	1.1.2. Editable	The model is built and kept by the assessment system, but instructors and/or students are allowed to modify its content.
	1.1.3. Negotiated	The model is agreed between the assessment system and the student that freely interacts with it through a dialogue.
	1.2. Closed	The model is shown neither to instructors nor to students as the aim is just to modify the behavior of the assessment system in order to be adapted to the student.
2. Representation of domain knowledge	2.1. Overlay	The student model is a projection of the domain model, i.e. the student knowledge is considered as a subset of the domain knowledge.
	2.2. Bug	The bug model is based on a library of possible mistakes that could be made up by the student.
	2.3. Perturbation	The perturbation model is a hybrid model that involves the concepts of the overlay and bug model together.
	2.4. Constraint-based	Opposite to the previous models, it does not compare the student's knowledge to the domain knowledge. It rather focuses on correct knowledge by checking if all the constraints of a certain domain are satisfied by the student.
3. Granularity	3.1. One student	The main goal of the model is to capture information from a particular student.
	3.2. Group of students	The model represents general information about a group of students.

Classifications of student models

According to [30] storing all the information in the student model in standardized formats allows for alternative externalizations of the student models and sharing of the information with other systems. Student models are thus reusable by different assessment and teaching systems and other applications. Different applications could interpret and portray the available data differently.

7. The concept map based knowledge assessment system

The overview given in the previous sections allows concluding that it is necessary to develop a direction of student model based subjective testing systems possessing intelligent and adaptive abilities in order computer-assisted assessment systems would be able to reach the level of assessment similar to the level of human-teachers and to provide appropriate flexibility regarding a particular student. It is important also to find reasonable balance between the chosen method of knowledge assessment and complexity of system's structure and functionality. An example of a system fulfilling the mentioned criteria is a concept map based knowledge assessment system [38, 39] developed by researchers from the Department of Systems Theory and Design of the Faculty of Computer Science and Information Technology of Riga Technical University during the last four years.

The mentioned system is based on concept maps representing knowledge in form of a graph which nodes correspond to concepts in a domain, but arcs indicate relationships between concepts. Concept mapping stimulate students to articulate and externalise their actual state of knowledge and provides a number of advantages. Concept maps allow assessment of the higher order cognitive levels according to Bloom's taxonomy [18], especially, when learners must provide the most prominent linking phrases or must identify the most significant cross-links in a concept map [40]. They allow the checking of the learners' understanding of interconnectedness of concepts mastered during the learning course, instead of a degree of memorization of separate facts. Concept maps are universal enough and independent from a subject, because a certain set of concepts and relationships among them constitute the greater part of learning courses. Moreover, they allow the development of computer-assisted knowledge assessment systems, which are based on the manipulation of graphic objects, that is, manipulations of the structure of the graph, its nodes and arcs, instead of natural language processing. Thus, they provide the less complicated structure and functional mechanisms of a system, as well as its independence from natural language.

The developed system allows the teacher to assess student's knowledge regularly, that is, at each stage of the learning course, and to use assessment results for the analysis and the improvement of learning content and teaching methods. At the same time the student can use the system for knowledge self-assessment in order to control and to keep track of his/her own learning progress. The system is used in the following way. The teacher creates one or more concept maps for a study course. The process of the creation of a concept map consists from the specification of relevant concepts and relationships among them. Teacher's created concept maps serve as a standard against which the students' concept maps are compared. During knowledge assessment the student solves a concept-map based task using initially given concepts and relationships. Maps created by students show how well students understand the learning material. After the student has submitted his/her solution, the system compares the concept maps of the student and the teacher, identify student mistakes, calculates the student's score and generates feedback which is delivered back to the student [41].

The concept map based knowledge assessment system incorporates the following two features related to the adaptivity: firstly, the degree of task difficulty automatically increases if the student has reached the teacher's specified number of points in the current assessment task, and secondly, automatic provision of such type of concepts' explanations which the system recognizes as the most suitable for the student taking into account student's characteristics. In turn, a student can control assessment process by the following features: manual reduction of the degree of task difficulty, automatic checking of the correctness of the student's created proposition, automatic insertion of the student's selected concept into the right node within the structure of the concept map and, finally, manual selection of the preferred type of concepts' explanations.

Adaptive behavior of the concept map based knowledge assessment system is based on the student model. The student model consists of static and dynamic information. The static part of the student model includes general information about the student (name, surname, identification card number, login name, email, etc.) and his preferences related to the type of concepts' explanation (definition, description or example of use). The dynamic part of the student model contains student knowledge level (received score for each map) as well as records of student made mistakes (set of incorrectly defined relationships for each map). Based on dynamic information the corresponding degree of task difficulty is selected for the student. The student model of the concept map based knowledge

assessment system can be characterized as closed, overlay, one student model in accordance with the classification given in Table 1.

The concept map based knowledge assessment system includes also some intelligent features which are related to the intelligent analysis and evaluation of students' concept maps. The system uses a new algorithm that has been developed especially for the intelligent comparison of student's and teacher's concept maps [39]. It is not based only on the isomorphism of both graphs, but is sensitive to the arrangement and coherence of concepts taking into account such aspects as the existence of a relationship, locations of both concepts, the type and direction of a relationship, the correctness of a linking phrase, etc. Application of this new algorithm is a discriminative feature of the system in comparison with other systems based on concept maps.

However, despite the intelligent nature of the evaluation process not all potential is used in the provision of informative and tutoring feedback to the students after the analysis of the solution. At present the generated feedback includes the overall student's score and the score for each composed proposition indicating whether or not a proposition is correct and, if not, then what exactly is erroneous. But such feedback is not really informative enough to clearly identify student's misconceptions and to direct future learning. Therefore, the next step in improvement of the system's functionality is to enrich feedback by performing the transition from the closed student model to the open student model. Information stored in the student model will be externalized with the aim to show the student how well he/she understands the concepts from the domain. Thus, a new version of feedback will additionally include the following information presented in a graphical format: student's results in comparison with other peers, statistic (percentage) on how well the student masters each concept presented in a map and finally recommendations to go to the next assessment task or probably to go to revision of relevant learning material. Thus, a new format of feedback can be used by the student in order to regulate successfully his/her individual learning process.

The current version of the system has been already experimentally evaluated in 7 learning courses with the participation of 149 students. Students positively evaluated the chosen approach to the knowledge assessment as well as the functionality of the system. But despite of the fact that the system has already reached the certain level of maturity and has been used successfully in practice future enhancement of the system related to the system's intelligence and adaptivity should be done in order to make the system even more useful.

8. Conclusions

Computer-assisted assessment systems provide real advantages in comparison with traditional paperbased assessment process, because they can save time and efforts needed to prepare assessment tasks, to conduct assessment activities, to check and evaluate students' works. Results of the research allow concluding that the most prominent development direction of computer-assisted assessment systems is student model based subjective testing systems with intelligent and adaptive capabilities, because they allow assessing higher order cognitive skills (such as analysis, synthesis, and evaluation) and offering of an individualized assessment scenario together with rich informative and tutoring feedback during the assessment process and after it. However, the development of a computer-assisted assessment system able to provide an appropriate level of adaptivity and to generate qualitative tutoring feedback is a hard work, because complex interdisciplinary researches should be done in order to understand what level of intelligence and adaptivity is required in computer-assisted assessment and how they should be achieved.

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Lukašenko R., Anohina A. Zināšanu vērtēšanas sistēmu apskats

Rakstā ir sniegts pārskats par datorizētām zināšanu vērtēšanas sistēmām. Tajā ir dota datorizētas zināšanu vērtēšanas vispārīga definīcija un ir aprakstītas objektīvas un subjektīvas testēšanas sistēmu pielietošanas iespējas, kā arī ir identificētas priekšrocības un trūkumi, kas attiecas gan uz datorizētu zināšanu vērtēšanu pašu par sevi, gan arī atsevišķi uz objektīvas un subjektīvas testēšanas sistēmām. Rakstā ir atspoguļota zināšanu vērtēšanas sistēmu vispārīga arhitektūra, noradot šādu sistēmu pamatkomponentes, to izpildāmas funkcijas un sadarbību, kā arī ir pamatota nepieciešamība nodrošināt intelektuālu un adaptīvu atbalstu zināšanu vērtēšanas sistēmās un ir aprakstīti minētā atbalsta izpausmes veidi esošās sistēmās. Turklāt, īpaša uzmanība rakstā ir veltīta studenta modelim, kas tiek izmantots, lai adaptētu sistēmu atsevišķa lietotāja vajadzībām, ir definēti modelī glabātas informācijas pamatveidi un šīs informācijas iegūšanas avoti, kā arī ir piedāvāts apkopojums par studenta modeļa klasifikācijām, ņemot vērā dažādus kritērijus. Rakstā ir arī sniegta informācija par intelektuālu un adaptīvu atbalstu uz jēdzienu tīkliem balstītajā zināšanu vērtēšanas sistēmā, kas tiek izstrādāta Rīgas Tehniskajā universitātē, kā arī ir identificēti minētā sistēma kritērijus.

Lukashenko R., Anohina A. Knowledge assessment systems: an overview

The paper gives on overview of computer-assisted assessment systems. The general definition of computerassisted assessment is provided and the application of objective and subjective testing systems is described. Moreover, advantages and drawbacks related both to computer-assisted assessment in general and to objective and subjective testing systems in particular are identified. The overall architecture of a computer-assisted assessment system in terms of components, their functions and interaction is presented. The necessity to provide intelligent and adaptive support in computer-assisted assessment systems is stated and kinds of the mentioned support in existent systems are described. Special attention is devoted to the student model that is used with the aim to adapt the system to the needs of a specific user. The basic kinds of information stored in the student model and their sources are defined, as well as the available classifications of the student model on the basis of different criteria are summarized. The paper also provides information on intelligent and adaptive support in the concept map based knowledge assessment system that has been developed at Riga Technical University, as well as identifies further development directions of the mentioned system.

Лукашенко Р., Анохина А. Обзор автоматизированных систем оценки знаний

Данная статья посвящена обзору автоматизированных систем оценивания знаний обучающихся. В ней приведено общее определение процесса компьютерного оценивания знаний и описано применение систем объективного и субъективного тестирования, а также идентифицированы преимущества и недостатки, которые относятся как к процессу компьютерного оценивания знаний в общем, так и к автоматизированным системам объективного и субъективного тестирования в частности. В статье представлена общая архитектура систем оценивания знаний с указанием основных структурных компонент, их функций и взаимодействия, а также обоснована необходимость обеспечения штеллектуальной и адаптивной поддержки в компьютерных системах оценивания знания и описаны виды этой поддержки в существующих системах. Кроме того, в работе особое внимание уделено реализации модели студента, которая используется в целях адаптирования системы к нуждам конкретного пользователя, определены основные виды информации хранящейся в модели студента и источники получения этой информации, а также предложено обобщение классификаций моделей студенита на основе различных критериев. В статье также приводится описание уровней интеллектуальной и адаптивной поддержки в разработанной в Рижском Техническом Университете системе оценивания знаний, основанной на использовании карт понятий и намечены дальнейшие пути развития разработанной компьютерной системы оценивания знаний.