

Feedback in the Concept Map Based Intelligent Knowledge Assessment System

Romans Lukassenko, *Riga Technical University*, Alla Anohina-Naumeca, *Riga Technical University*, Marks Vilkelis, *Riga Technical University*, Janis Grundspenkis, *Riga Technical University*

Abstract - The paper presents the concept map based intelligent knowledge assessment system developed by the Department of Systems Theory and Design of the Faculty of Computer Science and Information Technology of Riga Technical University. The main attention is devoted to the implementation of various kinds of feedback intended for promotion of effective learning and informing of a teacher about students' progress. The feedback is considered from three points of view: feedback generated automatically by the system and given to a student and to a teacher, and feedback provided by a student using questionnaires embedded into the system. All feedback types are discussed in detail and demonstrated using screenshots. Related works are presented as well. The calculation of the concepts' mastering degree and composition of the text summary informing a student about the best and the poorly known concepts within a task is described. The constituent parts of the questionnaire system (the questionnaire designer, the questionnaire filler and the questionnaire reporting system) are specified and all kinds of questions available in the questionnaire designer are demonstrated. The overall functionality of the system is presented paying attention to the goal of the system, scenario of the use and range of provided tasks.

Keywords: assessment system, concept map, concept's mastering degree, feedback, questionnaire

I. INTRODUCTION

Feedback is an essential part of any e-learning system that tries to achieve the human level of performance and to provide effective learning. In general, feedback is the various reactions of a teacher (a human or a system) to student's learning behaviour. Typically it takes the form of different messages like text, visual elements (bars, diagrams, and pictograms), sound, etc. Feedback encourages desired learning behaviour and discourages undesired one, allows understanding how successfully a student acts, whether he/she applies relevant knowledge, how far he/she is from the goal (completion of a task), and provides possibilities to correct misconceptions and to give recommendations for self-learning. Thus, feedback is considered as one of the most important sources of information to assist students in restructuring their knowledge [1].

According to [2] computer-provided feedback has the following advantages. First of all, unlike feedback from a human-tutor that can remain unbiased, accurate, and nonjudgmental, irrespective of student characteristics or the nature of the student response, computers can tirelessly provide feedback in response to student work. Secondly, the quality and type of feedback that can be implemented is limited only by the ingenuity and energy of course designers. Thirdly, computer-based feedback can, at least theoretically,

be adapted to the learning styles and needs of each individual student, a goal that seldom is attained in a traditional classroom. The mentioned advantages clearly indicate topicality of the scientific problem of the implementation of mechanisms of qualitative feedback within e-learning systems.

The paper presents results of efforts of researchers from the Department of Systems Theory and Design to implement different kinds of feedback in the developed intelligent knowledge assessment system which is based on concept maps. It is organized as follows. The mentioned system is overviewed in Section II. In Section III related works are presented and the scientific problem considered in the paper is highlighted. Feedback to a student and a teacher is described in Section IV. Section V is devoted to the questionnaire system and its main constituent parts. At the end conclusions and outline of future work is given.

II. OVERVIEW OF THE SYSTEM

The development of the concept map based intelligent knowledge assessment system started around four years ago [3] – [8]. It is a Web-based application which uses concept maps as a tool for knowledge assessment. A concept map (CM) is a kind of mental models based on a graph with labelled nodes corresponding to concepts in a problem domain and with arcs indicating relationships between pairs of concepts. Arcs can be directed or undirected and with or without linking phrases on them. A linking phrase specifies the kind of a relationship between concepts. A semantic unit of a CM is a proposition. Propositions are concept-relationship-concept triples which are meaningful statements about some object or event in the problem domain [9]. CM based tasks can be divided in 1) “fill-in-the map” tasks, where the structure of a CM is given to a student and he/she must fill it using the provided set of concepts and/or linking phrases, and 2) “construct-the-map” tasks, where a student must decide on the structure of a CM by him/herself.

The system has twofold goals in the context of the integration of technology into the traditional educational process: 1) to promote students' knowledge self-assessment, and 2) to support a teacher in systematic assessment of students' knowledge and the improvement of learning courses. It is used in the following way [10]. A teacher defines stages of knowledge assessment and creates CMs for all of them by specifying relevant concepts and relationships among them in such a way that a CM of each stage is nothing else then an extension of the previous one. During knowledge assessment a student solves a CM based task corresponding to a current

assessment stage. After a student has submitted his/her solution, the system compares a student's CM with the teacher's one and generates feedback.

At the moment the system offers 4 "fill-in-the-map" tasks (Task 0-insertion of linking phrases into the structure of a CM containing concepts, Task 1-insertion of concepts into the structure of a CM containing linking phrases, Task 2-insertion of concepts into the structure of a CM without linking phrases, Task 3-insertion of concepts and linking phrases into the structure of a CM) and 2 "construct-the-map" tasks (Task 4-creation of a CM from the given set of concepts, Task 5-creation of a CM from the given sets of concepts and linking phrases). Ten transitions between tasks are implemented allowing a student to find a task most suitable for his/her knowledge level. Five transitions increase the degree of task difficulty. They are carried out after the analysis of the student's solution if a student has reached the teacher's specified number of points in the current assessment stage without reducing the degree of difficulty of the original task. So, this is a system's adaptive reaction to the student's behaviour. Other five transitions reduce the degree of task difficulty and they are carried out by the voluntary request from a student during the solving of a task.

A teacher's created CM serves as a standard against which students' CMs are compared in the system. Moreover, a comparison algorithm [3] has been developed which 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 existence of a relationship, locations of both concepts, type and direction of a relationship, correctness of a linking phrase, etc. Two types of relationships are used in CMs: a) important relationships which show that relationships between corresponding concepts are considered as important knowledge in a learning course, and b) less important relationships that specify desirable knowledge. For each correctly provided important relationship a student receives 5 points, but for each less important relationship 2 points are assigned. At the moment the system can recognize more than 36 different patterns of correct and partly correct propositions in students' CMs [3]. Recently the improvement of the mentioned algorithm was made by considering the so called "hidden" relationships [11] in students' CMs which are nothing else than the derivation of relationships presented in a teacher's CM. The hidden relationships are recognized as correct too and could appear in students' CMs. They are scored with 1 point.

The system supports students' knowledge self-assessment as it makes the analysis and evaluation of students' CMs, as well as provides feedback which shows the student's errors. It promotes systematic knowledge assessment by providing opportunities to extend an initially created CM for other assessment stages. Moreover, statistical information about differences between students' CMs and a teacher's CM is collected giving possibility to a teacher to improve learning courses.

III. RELATED WORKS

The importance of feedback is well understood by researchers of the community of e-learning systems. In traditional computer-assisted assessment systems based on objective tests a student usually is provided with several kinds of feedback like scores of individual questions and the entire test, notification of the correctness of a response and written guidance, praise and study suggestions based on a student's response. Moreover, most systems allow tutors to enter their own feedback explaining why the response is wrong or to include hints which will be available during tests [12]. Teachers, in their turn, are presented with different reports showing students attendance of the course, their progress in tests and participation in course activities.

More advanced e-learning systems – intelligent tutoring systems – provide a mode of practical problem solving and implement more sophisticated feedback (for example, [13] – [14]). CosyQTI – an adaptive web testing system [15] – uses textual presentation of feedback to provide comments on proficiency level per topic and to list known and problematic concepts. The mentioned system presents graphical feedback in a form of bar charts to show overall performance score per topic, percentage of correct and incorrect answers and to compare student scores with average scores of other peers. In CAT system [16] bar charts are used to show a student's level of achievement (knowledge, comprehension or application) in each topic. Additionally, CAT presents to a student a text summary with recommended points for revision.

Regardless the fact that nowadays there are a lot of tools supporting different activities with CMs the great part of them provide only such functions as CM construction, navigation and sharing, but do not analyze students' created CMs and do not provide appropriate learner's support in terms of feedback and help. Among tools supporting the latter functions several systems are known. The simplest kind of feedback is implemented in the Verified concept mapper [17] presenting the results of the analysis of students' CMs in the form of messages related to erroneous or missing things in a learner's CM. Messages are mainly presented as questions, for example, "what is <concept> an example of?" or "what is the definition of <concept>?". However, the actual text provided to the learner is controlled totally by the teacher. The system in [18] displays hints given as partial propositions consisting of a concept and a relation, but hiding other concept. COMPASS [1] offers informative and tutoring feedback which is adapted to a particular student and includes error-task related questions, tutoring feedback and combination of both. COMOV tool [19] contains four different types of visual feedback (CM, concepts diagram, table and bar chart) and textual feedback. The visual feedback shows concepts within a topic in different colours according to the percentage of mastering of a concept. The textual summary provides three lists to a student: a list identifying how well the ten most important concepts have been understood, a list containing ten worst known concepts and a list including ten best known concepts.

The analysis made allows concluding that nowadays there are at least two challenging tasks in feedback problem that require solutions. First of all, developers of e-learning systems have been mainly concentrated on the implementation of feedback to a student and a teacher only. However feedback from a student to a teacher through a system is not provided. Such a kind of feedback presents a teacher with students' opinion about the functionality of a system, approach to tutoring and/or assessment and encountered problems. It can be used by system's developers in order to enhance system's functionality or by a teacher in order to improve learning courses and overall tutoring and/or assessment approach.

Secondly, implementation of feedback to a student and to a teacher within e-learning systems that use CMs for students' knowledge assessment is not such a trivial task as to provide information about correctness/ incorrectness of the solution as it is possible in computer-assisted assessment systems where questions have teacher's pre-defined set of answers. In turn, CM based systems are aimed not only to assess, but also to structure students' knowledge [1]. Therefore, feedback in those systems must be more advanced and should contain not only description of what exactly is wrong, but also some guidance what a student should do in order to improve understanding of the subject matter.

The next sections of the paper present authors' efforts in finding solutions of the mentioned problems. It is achieved by

implementing the following types of feedback in the CM based intelligent knowledge assessment system:

- Feedback from the system to a student: a labelled student's CM, quantitative and qualitative data, possibility to check a proposition and a teacher's CM;
- Feedback from the system to a teacher: labelled students' CMs and quantitative and qualitative data;
- Feedback from a student to a teacher through the system: answers on questionnaires.

IV. FEEDBACK TO A STUDENT AND A TEACHER

Only one type of feedback is provided to students during the solving of a task – checking of a proposition. The idea is that a student points out his/her created proposition and the system checks its correctness. In case of incorrectness the system presents explanations of both concepts involved in the proposition as it is shown in Fig.1.

After the submission of a task a student's CM and a window with quantitative and qualitative data is provided to a student. In the student's CM relationships are coloured in different tones according to their correctness. The student can acquire detailed information about each relationship by clicking on it. In this case contribution of all parts of a relationship (linking phrase, type, direction and placement of concepts) to the correctness of a relationship is shown (Fig.2).

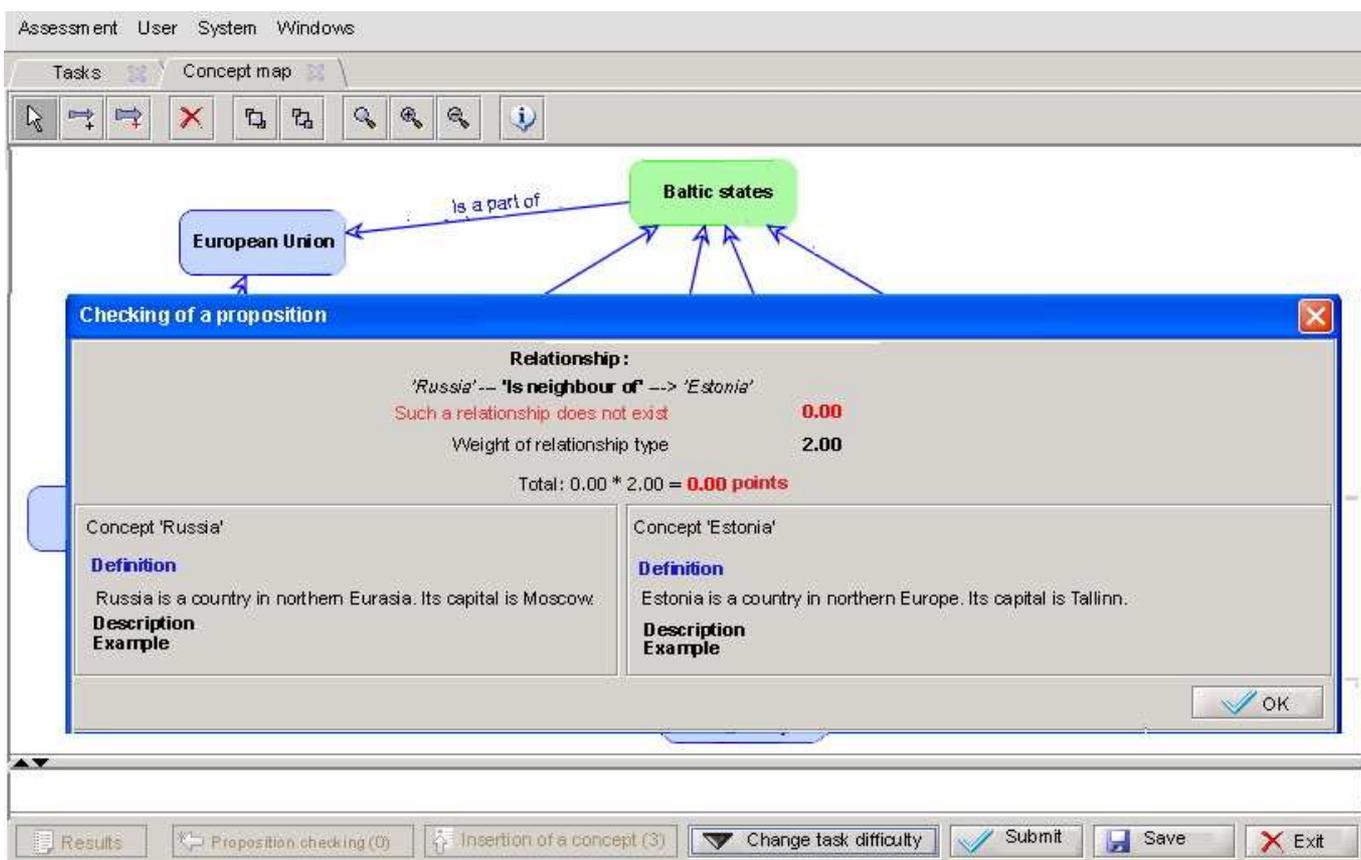


Fig. 1. Checking of a proposition

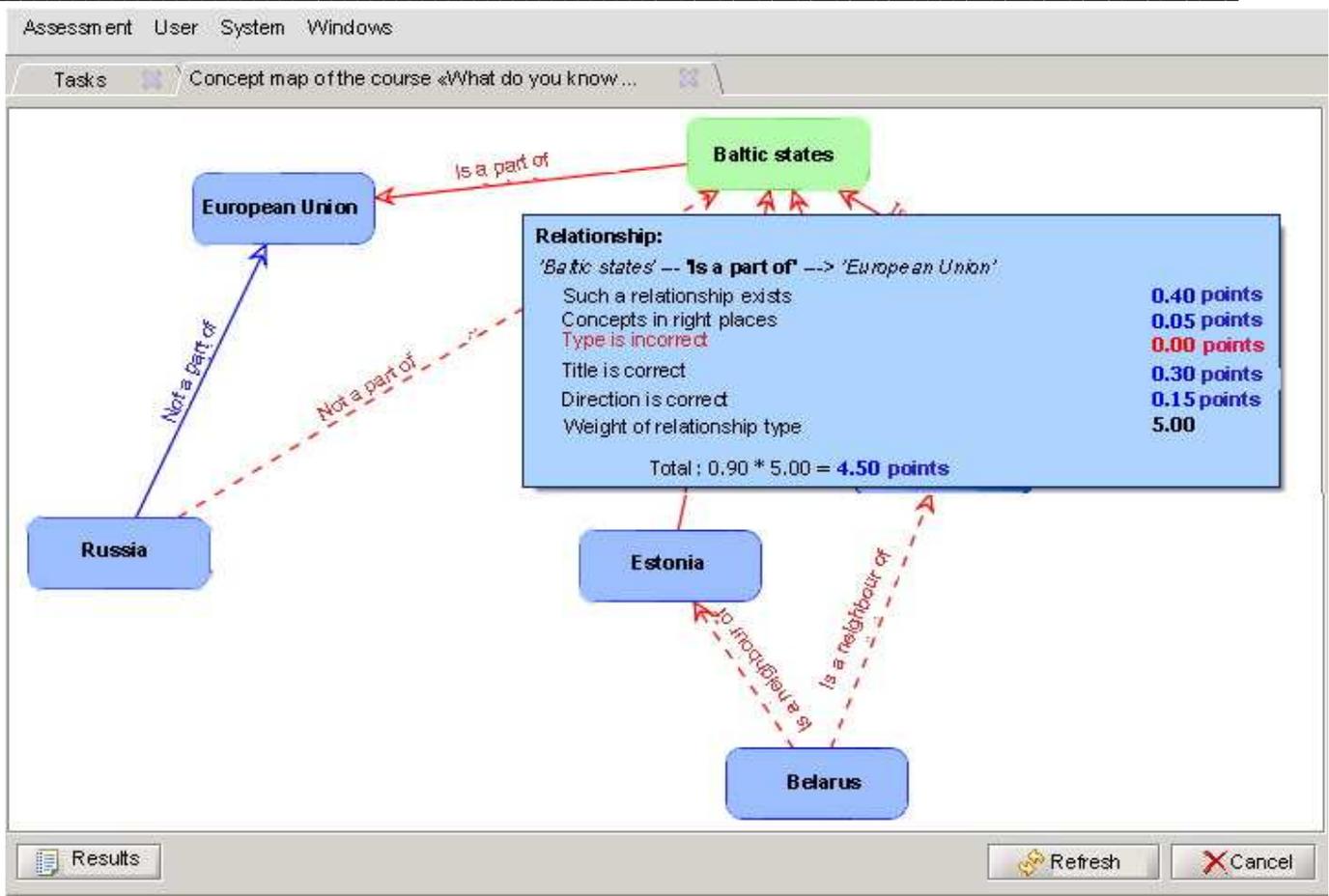


Fig. 2. A student's labelled CM

Quantitative data are a set of numerical indicators aimed to inform a student about his/her performance and degree of achievement in a given task. They are interpreted by the student him/herself and no explanation or pedagogical remarks are provided. A qualitative description is a text summary which explains a student how well he/she has mastered concepts in a given task. In addition, the text summary points out concepts which require revision. The both mentioned kinds of data are specified in Table 1.

The proficiency score for each concept and the comparison of the results of a student with the results of other peers are presented in a visual format. The following representation means are used: conceptual diagrams, tables, and bar charts. The qualitative data are presented as free text. The main rule for composition of textual feedback is that "feedback presented to the student should be as positive as possible" [15], so it should not discourage a student from working with the system in future.

Fig.3 demonstrates feedback generated by the system. Quantitative parameters are shown in the upper half of the window. The lower half of the window contains qualitative description. Feedback generated by the system can be easily exported to an external .html file and accessed by a student afterwards to inspect the results once again or to print them, as well as discuss with a teacher.

An approach for the acquiring the actual student's score per stage was already described in [20]. This paper pays attention to the calculation of concepts' mastering degrees and to the composition of the text summary which are the most informative parts of the generated feedback.

The calculation of concept's mastering degree (CMD) is based on the analysis of correctness of incoming and outgoing relationships of a concept. The following formula is used to acquire CMD:

$$CMD = \frac{LC}{LC_{\max}} \cdot 100\% = \frac{\sum_{i=1}^N lc_i}{\sum_{i=1}^N lc_i^{\max}} \cdot 100\% \quad (1)$$

where

- CMD – the concept's mastering degree;
- LC – total points received by a student for all relationships of a concept;
- LC_{max} – maximum number of points that a student can get if all relationships of a concept are defined correctly;
- lc_i – points received by a student for i-th relationship of a concept;
- lc_i^{max} – maximum number of points that a student can get if i-th relationship of a concept is defined correctly;
- N – number of relationships of a concept.

TABLE 1
QUANTITATIVE AND QUALITATIVE DATA GENERATED BY THE SYSTEM

Type of information	Parameter	Goal
Quantitative data	Actual student's score in a given task	To inform a student about his/her performance in a given task, degree of independence and about his/her results in comparison with peers
	Average score received by other students in the same task	
	Maximum possible score for a task	
	Points received for created relationships	
	Points spent for the use of help	
	Calculation process of the student's score	
	Time used by a student to complete a task	
	Total time given to complete a task	
	Type and amount of help used by a student during the solving of a task	
	Rate of proficiency for each concept in a task	
Qualitative data	Text summary	To inform a student about the best and the poorly known concepts within a task and to give recommendations for revision of specific learning materials

The value of CMD shows how well a student understands a given concept and it can range from 0 (the student does not understand a concept at all) to 100 percent (the student understands a concept perfectly). The color of a concept in the feedback window (Fig.3) depends on the CMD value: red color stands for unknown concepts (lower interval of CMD values), yellow color stands for poorly known concepts (middle interval of CMD values) and green color stands for well known concepts (higher interval of CMD values).

Composition of the text summary is based on the analysis of the content of a CMD's table from the feedback window. First of all, values for four flags – AllGreen, MostGreen, YellowExists and RedExists – are set during the analysis of the CMD's table. The flag AllGreen means that all concepts in the table are in green color. The flag MostGreen means that more than half of concepts in the table are in green colour. The flag YellowExists means that at least one concept in the table is yellow. The flag RedExists means that at least one concept in the table is red. The possible values of the flags are "Y" – Yes (or True) and "N" – No (or False). After values for flags are set, the structure of the summary is chosen depending on values of the flags.

Seven rules existing in the system for choosing the summary's structure are given in Table 2. Text variables Header, Z1, Z2, D1, S1 and Footer hold specific predefined values and stand for parts (paragraphs) in the text summary. Header is a welcome message to a student. It is a mandatory part of the text summary. Z1 is a congratulation message. It

will be included in the text summary if the value of the flag AllGreen is "Y". Z2 is another congratulation message. It will be included in the text summary if the value of the flag MostGreen is "Y". D1 is a suggestion for revision of specific concepts. It will be included in the text summary if the value of the flag YellowExists is "Y". Z1 is another suggestion for revision of specific concepts. It will be included in the text summary if the value of the flag RedExists is "Y". Footer is a signature and it is a mandatory part of the text summary.

In general, the text summary contains two lists of concepts: the list of poorly known concepts (yellow concepts) and the list of unknown concepts (red concepts). The system advises kindly to revise learning materials regarding yellow concepts, and the system insists on studying hard learning materials regarding red concepts.

Values of the text variables Header, Z1, Z2, D1, S1 and Footer as well as colours for concepts depending on CMD values are defined in a feedback's configuration window which is shown in Fig.4. The system administrator is responsible for the configuration of feedback parameters which are applied to all courses registered in the system.

The last type of feedback shows a student a correct teacher's CM after tasks of all assessment stages are completed.

The feedback provided to a teacher is similar to one given to a student, that is, a teacher at any time can examine students' labelled CMs (Fig.2) and quantitative and qualitative data specified in Table 1.

TABLE 2
RULES FOR DEFINING THE STRUCTURE OF THE TEXT SUMMARY

Rule	Flag values	Structure of the summary
1	AllGreen = Y, MostGreen = N, YellowExists = N, RedExists = N	Header + Z1 + Footer
2	AllGreen = N, MostGreen = Y, YellowExists = Y, RedExists = Y	Header + Z2 + D1 + S1 + Footer
3	AllGreen = N, MostGreen = Y, YellowExists = Y, RedExists = N	Header + Z2 + D1 + Footer
4	AllGreen = N, MostGreen = Y, YellowExists = N, RedExists = Y	Header + Z2 + S1 + Footer
5	AllGreen = N, MostGreen = N, YellowExists = Y, RedExists = Y	Header + D1 + S1 + Footer
6	AllGreen = N, MostGreen = N, YellowExists = Y, RedExists = N	Header + D1 + Footer
7	AllGreen = N, MostGreen = N, YellowExists = N, RedExists = Y	Header + S1 + Footer

Teacher Questionnaires User System Windows

Concept maps Results

Course: Methods of Systems Theory Stage: 1/1 Degree of task difficulty: 4/6 Mode: assessment

Score: 8.50 points (31.48%)
Time spent: Not defined

Calculation process of the score

Coefficient of the degree of task difficulty (g): 0.80
Points for relationships (pa): 8.40

Usage of help:

Help type	Frequency (n)	Penalty (s)	Penalty growth (d)	Correction coefficient (s*n+d*(n-1)^2)
Insertion of concepts	0/0	0.02	0.02	(k1) = 0.0
Explanations of concepts	0	0.02	0.025	(k2) = 0.0
Checking of propositions	0/0	0.01	0.02	(k3) = 0.0

Score (Ps): $P_s = pa * g * (1 - (k_1 + k_2 + k_3)) = 8.4 * 0.8 * (1 - (0.0 + 0.0 + 0.0)) = 8.5$

Statistics by the degree of task difficulty

Degree	Max score	Average score
1	27.0	None
2	27.0	None
3	27.0	None
4	27.0	None
5	27.0	None
6	27.0	None

Concept mastering

Concept	Degree of mastering
Systems engineering	100.0%
Systems analysis	100.0%
Systems approach	100.0%
Operation research	100.0%
Bionics	100.0%
Cybernetics	0.0%

Individual plan for revision of study materials

Dear Student!

You have mastered a major part of concepts!
Some concepts are unknown, you must revise the following concepts:
- Cybernetics

Good luck!

Save Atcell

Fig. 3. Quantitative and qualitative data generated by the system

File Administrator User System Windows

Feedback configuration

Concept mastering ranges (%)

Title	Left boundary	Right boundary
Best known	79.0	100.0
Poorly known	40.0	79.0
Unknown	0.0	40.0

Text variables

Label	Title	Usage	Message
Header	Header	<input checked="" type="checkbox"/>	Dear Student!
Z1	All concepts are well known	<input checked="" type="checkbox"/>	Congratulations! You have mastered all concepts
Z2	Most concepts are well known	<input checked="" type="checkbox"/>	You have mastered a major part of concepts
D1	Some concepts are poorly known	<input checked="" type="checkbox"/>	You know some concepts poorly! Please, revise the following concepts:
S1	Some concepts are unknown	<input checked="" type="checkbox"/>	Some concepts are unknown! You must revise the following concepts:
Footer	Footer	<input checked="" type="checkbox"/>	Good luck!

Save Refresh Cancel

Fig. 4. The feedback configuration window

V. THE QUESTIONNAIRE SYSTEM

The questionnaire system embedded in the knowledge assessment system is logically divided into three parts: 1) a questionnaire designer used by teachers for the creation of inquiries; 2) a questionnaire filler intended for filling available inquiries by students, and 3) a questionnaire reporting system allowing teachers to sort and manipulate results of inquiries.

Only teachers can create and edit questionnaires. Each questionnaire can be assigned only to one study course. However, there might be several questionnaires for the same course. So the relationship between study courses and questionnaires is one-to-many. Teachers can edit only those questionnaires, which belong to their courses. However, possibility to copy existing questionnaires of other teachers is provided. After the questionnaire is copied, it can be also edited and deleted.

A questionnaire becomes available to students only after a teacher has published it. When a student opens a teacher's questionnaire for the first time, a student's copy is created, because a teacher's questionnaire includes questions only. A student's inquiry contains the set of answers which are referenced to the appropriate questions from a teacher's questionnaire.

A. The Questionnaire Designer

The purpose of the questionnaire designer is to provide tools for the creation and editing of questionnaires by teachers. Fig. 5 shows the main window of the designer.

At the top of the window there is a questionnaire header which must be filled by a teacher. It contains a field for entering the name of an inquiry, the list of study courses from which an appropriate course must be selected and a special

check box making a questionnaire visible or invisible for other teachers.

At the bottom of the window there are four buttons. A publishing button makes a questionnaire available for students and an inquiry becomes not editable until it is unpublished again. Other buttons are responsible for saving a questionnaire in the database, reloading from the database and cancelling, respectively.

There are several buttons at the left side of the window, as well. Some of them correspond to the following types of questions available in the system:

1. An essay question. It demands from a student just to type an answer in the form of free text. This type of questions is the worst one from the statistics gathering point of view, because it could not be automatically processed. So the first button in the main window of the questionnaire designer adds an essay question to a questionnaire (Fig. 6).
2. Multiple response questions. For this question type a teacher defines several possible answers. Filling a questionnaire, students can select one or more answers which they consider to be right answers. This type of questions is suitable for statistics gathering, because items are predefined, sortable and easy processable. Fig. 7 illustrates the appropriate button and user interface for such type of questions.
3. Multiple choice questions. This type of questions is similar to a previous one except that a student can choose only one answer from all predefined items. The corresponding button and an example of the question are shown in Fig. 8.

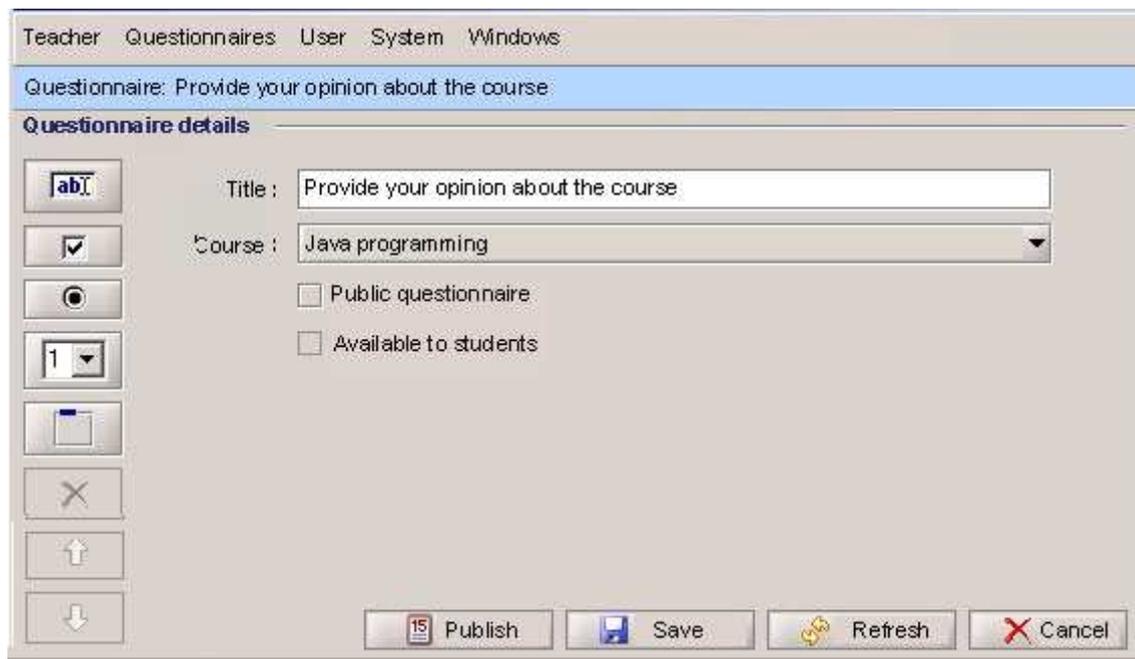


Fig. 5. The main window of the questionnaire designer

Fig. 6. An example of an essay question

Type	Number	Comments	Possible answers
<input checked="" type="checkbox"/>	1	<input checked="" type="checkbox"/>	Definition of a concept
<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	Description of a concept
<input checked="" type="checkbox"/>	3	<input checked="" type="checkbox"/>	Example of a concept

Fig. 7. An example of a multiple response question

Type	Number	Comments	Possible answers
<input type="radio"/>	1	<input checked="" type="checkbox"/>	Static approach
<input type="radio"/>	2	<input checked="" type="checkbox"/>	Adaptive approach
<input type="radio"/>	3	<input checked="" type="checkbox"/>	I don't know

Fig. 8. An example of a multiple choice question

Type	Number	Possible answers
▼	1	Changing the degree of task difficulty
▼	2	Explanations of concepts
▼	3	Insertion of concepts
▼	4	Checking of propositions

Fig. 9. An example of a ranking question

4. Ranking questions. This type of questions requires a student to rank given answers by provided ranks. Fig. 9 displays that in order to construct such a question a teacher must define a question phrase, answer items and also ranks, which will be assigned by students to the answer items. An example illustrating this type of questions is the following. A teacher defines a question phrase “Please, order types of help which were used by you during the task completion. Put the highest rank values to the types, which helped you most”. The types of help are: 1) Changing the degree of task difficulty; 2) Explanations of concepts; 3) Insertion of concepts; 4) Checking of propositions. So students must select an appropriate rank for each type of help. If a person thinks that explanations of concepts was the most useful for him/her, than he/she will select rank 4, etc.

The questionnaire designer provides also possibilities to add informative messages, fields for acquiring comments from a student and section titles, as well as there are handy tools for changing positions and deleting of questions.

B. The Questionnaire Filler

The questionnaire filler is available for students only. A student can fill a questionnaire at any time, when he/she is working with the system. However, when a student finishes a task of the last assessment stage, the system automatically shows appropriate inquiries to be filled.

The questionnaire filler is a simple form containing questions and their answers or fields for entering answers. After the completion of a questionnaire, a student must press a button “Submit” in order to save his/her answers in the database. The questionnaire is accessible at the teacher’s side as soon as it was saved for the first time.

C. The Questionnaire Reporting System

The questionnaire reporting system allows a teacher to view results of inquiring. It provides three possibilities:

1. Viewing and sorting of students’ questionnaires using filters “by a student” and “by a questionnaire”.
2. Report on students’ answers by questions. It allows a teacher to sort different students’ answers by specifying the following filter parameters: student, questionnaire, question type and question. This is very useful report, because a teacher can see which answers were given by students for a particular question or which answers were given for all questions with type “essay question”, and so on (Fig. 10).

Student	Questionnaire	No	Question	Question type	Answer
SMark Vilkelis	Provide your opinion about the course	1	What information do you want to receive as a result?	Essay question	Nothing
SMark Vilkelis	Provide your opinion about the course	2	Which types of help did you use?	Multiple response	Definition of a concept Example of a concept

Fig. 10. A part of the report on students’ answers by questions

Questionnaire	Question type	No	Question	Answer	Number of answers	Students
Provide your opinion ...	Multiple response	2	Which types of help did yo...	Definition of a concept	1	[5Mark Vilkelis]
Provide your opinion ...	Multiple response	2	Which types of help did yo...	Description of a concept	1	[5Mark2 Johansons]
Provide your opinion ...	Multiple response	2	Which types of help did yo...	Example of a concept	2	[5Mark Vilkelis, 5Mark2 Johansons]

Fig. 11. A part of the report on answers' statistics

3. Report on answers' statistics. It allows a teacher to examine how many students gave the same answers for a specific question. Three parameters can be used for filtering: questionnaire, question type and question. This report cannot be applied for essay questions. Fig.11 displays the mentioned report.

The specified reports can be exported in Excel files, so it is possible to process gathered statistics further, for instance, to draw some charts, print them or to apply any others mathematical or statistical methods, which are available in the Excel software.

VI. CONCLUSIONS AND FUTURE WORK

In technology enhanced tutoring systems the role of feedback could not be overestimated. Feedback is one of the most important sources of information to assist students in restructuring their knowledge as well as to motivate and encourage them during the learning process. That is why implementation of different forms of feedback must be in focus of developers of any kind of computer-based learning system. In the intelligent knowledge assessment system developed by researchers of the Department of Systems Theory and Design two types of system's feedback, namely, to a student and a teacher have been implemented. During task solving students may receive feedback in form of proposition checking, while after the completion of a task they get a labelled CM and quantitative and qualitative data about their solution. The feedback provided for a teacher is similar to that given to a student. In order to get students' opinion about the approach and functionality of the system the questionnaire system is developed and implemented. It provides the third type of feedback implemented in the system – feedback from a student to a teacher through the system. The questionnaire system makes the inquiry process and processing of gathered statistics much easier. At the same time usage of the questionnaire system has revealed several deficiencies which should be eliminated in future.

The possible extension of the questionnaire designer in future might be related to the integration of possibility to add images to questions and new question types. At the moment questions in questionnaires are organized as a long list and it is not very handy to scroll through the inquiry. In future it is planned to group 3-5 questions in one page.

To improve the questionnaire filler the same thing as for the designer can be introduced, that is, grouping of questions by

pages. Other possible improvement is to add an attribute showing a status of a student's questionnaire. In case if a student has not completed the whole questionnaire, but just only answered some questions, it possibly does not make any sense to show the half of whole work for the teacher. If the work is completely finished only then teacher could see the results.

New reports and possibility to generate charts based on questionnaire results could be integrated, as well. It will make the system independent on third part software.

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Romans Lukassenko obtained the master degree in Computer Systems from Riga Technical University in 2006.

He is a PhD student of Computer Systems at the Riga Technical University

Romans Lukašenko, Alla Anohina-Naumeca, Marks Viļķelis, Jānis Grundspenķis. *Atgriezeniskā saite jēdzienu tīklos sakņotā intelektuālā zināšanu vērtēšanas sistēmā*

Dotais raksts ir veltīts jēdzienu tīklos sakņotai intelektuālā zināšanu vērtēšanas sistēmai, ko ir izstrādājuši Rīgas Tehniskās universitātes Datorzinātnes un informācijas tehnoloģijas fakultātes Sistēmu teorijas un projektēšanas katedras pētnieki. Galvenā uzmanība ir pievērsta dažādu veidu atgriezeniskās saites realizācijai, ar mērķi veicināt efektīvu mācīšanās un skolotāja informēšanu par studentu progresu. Atgriezeniskā saite tiek apskatīta no trim redzes viedokļiem: atgriezeniskā saite, ko sistēma ģenerē automātiski un izvada studentam un skolotājam, un atgriezeniskā saite, ko students sniedz, izmantojot sistēmā esošas aptaujas. Visi atgriezeniskās saites veidi ir apskatīti detaļās un ir demonstrēti, izmantojot sistēmas ekrānu izdrukas. Rakstā ir arī atspoguļoti saistītie darbi. Jēdzienu apgūšanas pakāpes izskaitļošana un teksteida apkopojuma, kas informē studentu par vislabāk apgūtiem jēdzieniem un vissliktāk apgūtiem jēdzieniem uzdevuma ietvarā, sastādīšana ir aprakstīta. Aptauju sistēmas sastāvdaļas (aptauju izveidotājs, aptauju aizpildītājs un aptauju pārskatu sistēma) ir specificētas un visu veidu jautājumi, kas ir pieejami aptauju izveidotājā, ir demonstrēti. Sistēmas kopēja funkcionalitāte ir atspoguļota, uzmanību veltot sistēmas mērķim, izmantošanas scenārijam un piedāvātu uzdevumu klāstam.

Роман Лукашенко, Алла Анохина-Наумец, Марк Вилькель, Янис Грудспенькис. *Обратная связь в основанной на сетях понятий интеллектуальной системе оценки знаний*

Данная статья представляет основанную на сетях понятий интеллектуальную систему оценки знаний, которая была разработана исследователями кафедры теории систем и проектирования Факультета компьютерных наук и информационной технологии Рижского технического университета. Главне внимание уделено реализации разнообразной обратной связи, цель которой способствовать эффективному обучению и информированию преподавателя о прогрессе студентов. Обратная связь рассматривается с трёх точек зрения: обратная связь, генерируемая системой автоматически и выводимая студенту и преподавателю, и обратная связь, предоставляемая студентом посредством анкет, имеющихся в системе. Все типы обратной связи рассматриваются в деталях и демонстрируются, используя экранные распечатки системы. В статье представлены также связанные работы, описан расчёт степени усвоения понятий и составление обобщающего текста информирующего студента о наиболее хорошо усвоенных понятиях и наиболее плохо усвоенных понятиях в рамках задания, а также специфицированы составные части системы анкетирования (создатель анкет, заполнитель анкет и система отчетов по анкетам), продемонстрированы все виды вопросов имеющиеся в создателе анкет и описана общая функциональность системы, главное внимание уделяя цели системы, сценарию использования и предложенному набору заданий.

currently. His thesis subject is implementation of a student model for the software knowledge assessment system. Romans Lukassenko works also as a researcher at the Department of Systems Theory and Design of Riga Technical University in Latvia. His main research fields are intelligent tutoring systems, computer-assisted assessment systems and student modelling. He has participated in a pair of research projects related to the development of educational software.

Alla Anohina-Naumeca obtained her Dr.sc.ing. degree in 2007 from Riga Technical University.

She is a Lecturer at the Department of Systems Theory and Design of Riga Technical University in Latvia. She has eight years' experience of teaching in the field of computer science both in Riga Technical University, and in other educational institutions in Latvia. Her main research fields are intelligent tutoring systems, computer-assisted assessment systems and artificial intelligence. She has participated in several research projects related to the development of educational software.

Marks Vilkelis obtained the master degree from the Institute of Information Technology of Riga Technical University in 2009. His master thesis was "The knowledge assessment system as a client-server java application".

Marks Vilkelis is a PhD student of Riga Technical University, Department of Systems Theory and Design. His professional activities are related to the programming of complex business applications in the international software development company. His scientific interests cover Java open source technologies and applications of artificial intelligence. He has experience of working as a programmer in some research projects.

Janis Grundspenkis received his Dr.sc.ing. degree in 1972 and Dr.habil.sc.ing. in 1993 both from Riga Technical University in Latvia.

He is a Professor at the Department of Systems Theory and Design, a Head of the mentioned department, a Dean of the Faculty of Computer Science and Information Technology and the Director of the Institute of Applied Computer Systems of Riga Technical University.

His research interests are agent technologies, structural modelling, knowledge engineering and management. He is the member of IEEE and ACM. He is a full member of Latvian Academy of Science.