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Abstract:

In distance learning supported by LMS, it is extremely important to provide automated or partially automated feedback about learning outcomes to students as well as feedback about the efficiency and quality of teaching and learning to teachers and to management of the institution that provides web-based learning courses.
In this article, we present the solutions implemented in the LMS eCampus that are theoretically grounded and have been proved in praxis.

1   Introduction

Many researchers in the field of usability evaluation of computer software or human computer interaction (HCI) agree that providing feedback is one of the essential facilities of appropriately designed systems [2, 10, 11, 13]. The system should always keep users informed about what is going on through appropriate feedback within reasonable time. However, feedback is crucial to the designers of the system as well. Focus groups of representative students can provide feedback on a given instructional design and help designers to improve usability and user-friendliness of the system [10, 12].

In the field of web-based learning, the system is usually called learning management system (LMS). LMS should enable content (e.g. learning objects, e-courses) creation and delivery, and should provide learning environment with the tools for collaboration and communication, assessment, evaluation and for preparation of various surveys to teachers and to students.

As feedback is the word that is emphasised in modern education, the LMS's tools created to provide feedback are meaningful to the teachers (e.g. tutors, facilitators, mentors) and to the students.

Consequently, providing feedback is important for application design as well as from a pedagogical perspective. However, the focus of this article is on the pedagogical aspects of feedback and implementation of tools to collect it in the LMS eCampus.

2   Feedback in web-based learning

2.1   Application design perspective

Dringus [7, 8] and Squieres [13] propose that usability heuristics summarized by Nielsen [10] can be applied to evaluate e-learning application interfaces as well as the other application interfaces. Providing informative feedback is one of these heuristics. According to Nielsen, the mechanism for providing "public" and "private" feedback to users should be implemented in the system [10].

Squieres [13] states that the environment should provide the student with intrinsic feedback, which represents the effects of the student's action on the system, environment or artefact.

2.2   Pedagogical perspective

Chickering and Gamson [4] state seven principles for good practice in undergraduate education that are frequently cited in the literature:

– encourage student-faculty contact,
– encourage cooperation among students,
– encourage active learning,
– give prompt feedback,
– emphasize time on task,
– communicate high expectations, and
– respect diverse talents and ways of learning

Chickering and Ehrmann [5] argue that implementing these principles is also essential in technology based education.

Laurillard (2002) analyses how students gain knowledge. The essential steps are active learning, feedback, and reflection [9]. Piaget (cited in [15]), the protagonist of constructivist theory, states that students build new knowledge on previously acquired knowledge and experiences. Therefore, students should proceed learning a new subject on already assimilated knowledge. Furthermore, formative evaluation of knowledge and knowledge consolidation could be an effective learning strategy.

This strategy can be supported automatically in WBL. When the students learn via web, they can receive fast and simultaneous feedback to verify gained knowledge, if the learning objects and/or the LMS system are appropriately designed.

Therefore we can conclude that in learning objects, as well as in e-courses, formative online questions that give instant feedback are highly recommended, as they allow students to check comprehension and gained knowledge. After studying learning material, students need to evaluate gained knowledge and verify if assimilated knowledge meets teacher's expectations. One of the options to do this is summative knowledge evaluation via test.

Barron (2007) represents top ten secrets of effective e-learning in his qualitative research. Giving constructive and meaningful feedback is one among them. Barron found out that although the quantitative data derived from a numerical score from a summative knowledge evaluation (e.g. online test) was helpful, students demanded narrative feedback as well. In addition to automatic feedback, they wanted their work to be thoughtfully critiqued by the facilitator (e.g. teacher, tutor). Barron mentions that "if there is one thing that students agree upon vehemently, it is the desire for timely, detailed, meaningful feedback". In this study students also report that they need public as well as private feedback. In addition to public forum with all students, students want an opportunity to communicate one-to-one with the facilitator throughout the course. The facilitator can handle this via e-mail or provides private discussion space for each student that is only accessible to an individual student. In addition to expecting facilitators to respond to their online discussion posts and assignments, students appreciate regular summaries where the teacher pulls ideas together, to illustrate strategic points in the course as the discussions progress [3].

Students should also receive feedback through evaluations and reflective discussion questions in the course from the teacher and from other students. According to Vygotski, students achieve more if they are supported and guided. Student's potential development determined through the problem solving under guidance or, in collaboration with more capable peers, is higher than the level determined by independent problem solving. This concept is known as the zone of proximal development [14].

Feedback clarifies the questions arising in communication and increases the possibility to complete the learning task.

Therefore, LMS should have integrated tools that enable private conversation (e.g. email, skype) and group communication or collaboration (e.g. via forums, chat, videoconference system) to provide private and public feedback.

In many e-courses, students need to complete tasks and send them to the teacher. Addressing the principle of prompt feedback, two types of feedback are required. The system should give immediate acknowledgement feedback upon receipt of an assignment since the student lacks the assurance of physically handing the assignment. Prompt information feedback regarding the content of the student's work is required as well [1].

Teachers and course designers also need feedback. In user centric design, "iterate" is one of the major principles. We cannot expect to build something perfect the first time. Therefore, the advice is: "Build a prototype and evaluate it; then fix what doesn't work; evaluate and redesign until it is good enough to release" [12]. In the design of web-based courses this is even more important. Furthermore, in web-based learning we should search for new teaching strategies. If the educational practice is developed strictly on the basis of an existing practice, the implementation of new technologies will result in a remediation of the existing learning activities i.e. a transfer of the existing learning activities from physical locations to a virtual environment. In order to develop e-learning or distance learning from a pedagogical point of view, it is necessary to have an understanding of theoretical principles of the learning process [6]. Researchers suggest implementation of constructivist learning and teaching strategies that enhance learning (e.g. scaffolding, collaboration, cooperation). In searching for optimal e-course design, the use of the "iterate" principle is essential. Therefore, course designers (e.g. teachers) also need feedback.

3   Using eCampus to provide feedback

The eCampus is a web-based application, designed for creating web-based learning contents, different kinds of courses, and carrying out web-based and blended learning. eCampus enables the use of web-based pedagogical tools as scaffolds for self regulated learning (SRL), such as collaborative and communication tools, content creation and delivery tools, administrative tools and assessment tools. Key SRL processes, such as goal setting, self-monitoring, self-evaluating, help seeking and time management, which affect students' achievements and motivational beliefs, are implemented. Learning with the help of eCampus is an active process where the strategy of "learning by doing" leads the student to cognitively approach and work through the learning material and to create links between experiences, existing knowledge and new knowledge.

The learning contents created in eCampus are interactive, rich on multimedia and adjusted to different learning styles of students (e.g. visual, audio or kinaesthetic). The student's activity is furthermore stimulated by simultaneous on-line questions, where the student receives feedback information regarding the understanding of the subject and can eventually get a tip for further learning. eCampus provides an interactive on-line evaluation of knowledge at the beginning of learning, during the learning process and after the learning unit is completed. Different tools that give automatic feedback to students are available, e.g. online questions that give instant feedback and various types of tests. The teacher can offer non-automated or partially automated feedback using collaborative and communication tools (e.g. forums, personal massages, skype, chat). Furthermore, tools that provide feedback to the teacher and/or other responsible persons are also integrated in the system.

By using the eCampus system, we can create (not just import) hypermedia learning objects in SCORM format.

3.1 Enabling feedback to students and teachers

The author can use the content editor. Figure 1 shows how the author creates a learning page and appends the online question. The question has to be previously prepared in the question editor.

The author of hypermedia learning content (e.g. learning object) can put interactive questions on any learning page. Various types of questions can be used, such as one-choice, multiple-choice, gap-fill and open questions. The author chooses the question among previously created questions. After answering, the student gets the answer. The default feedback is correct or false. However, the author can set more detailed expressions (e.g. well done, read the text carefully and try again). A feedback message (e.g. correct, false) appears in green colour bar if the answer is correct or in red colour bar, if the answer is false.

The tool allows generating static feedback or dynamic feedback, dependent on the answers submitted by students. Using this option, the author can create different learning paths.

This option enables creation of interactive and visually attractive learning materials that enforce student's activity and therefore learning effectiveness.
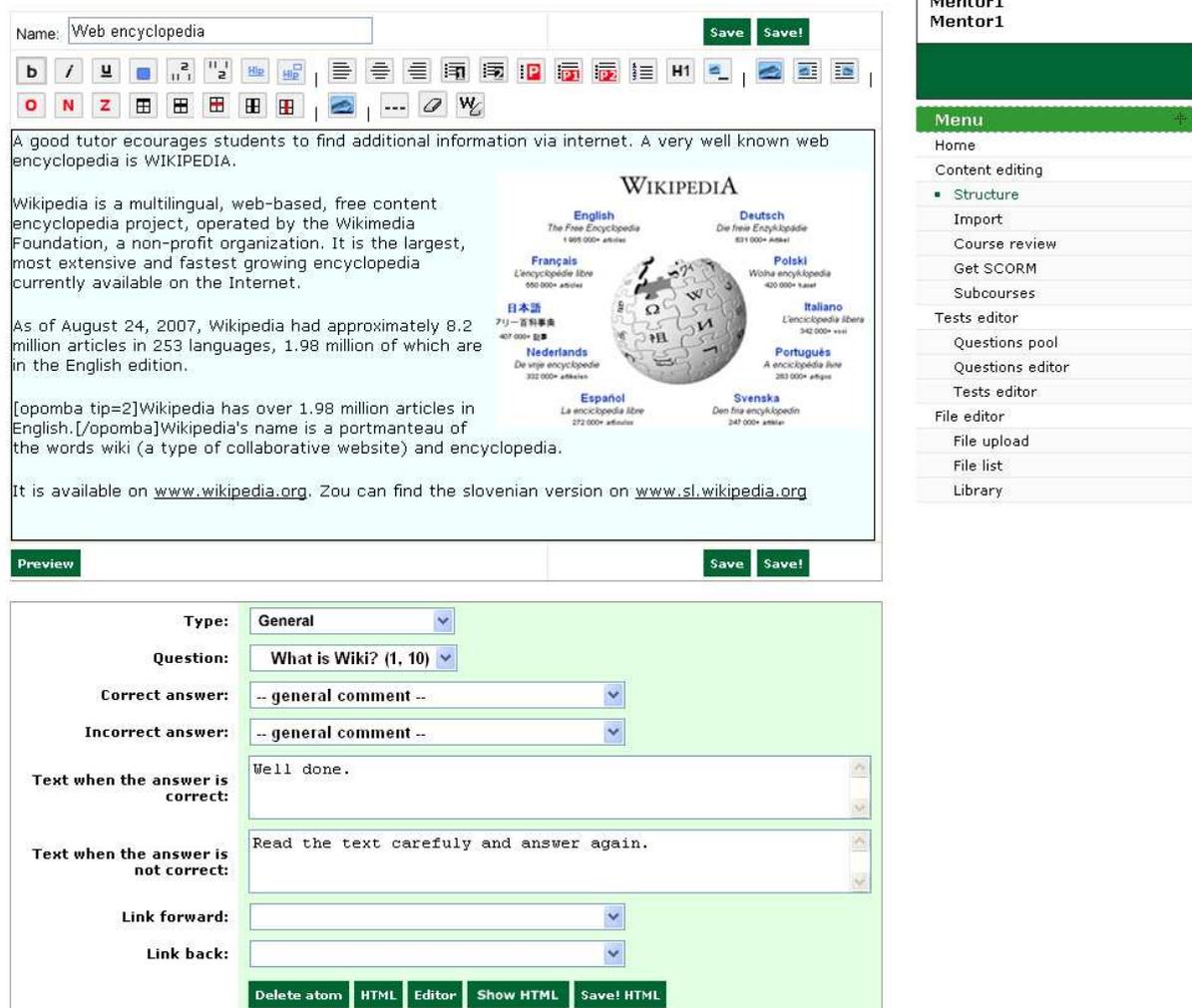

Fig. 1

Figure 2 shows the student's view of the same learning page.

Fig. 2

After answering the question, the student is informed if the answer is correct. If the author specified so, the student's answer is used for the selection of the next learning page.

Figure 3 shows the question editor. The author should define the level of difficulty (e.g. low, medium, high), type of question (e.g. one-choice, multiple-choice, gap-fill, open) and whether the question is intended for formative or summative (e.g. test) evaluation. Furthermore, he/she has to define the question and the answers. The editor for creating and formatting the question and the answers is also available. The author can use multimedia elements (e.g. text, visual and audio images) and hyperlinks in questions.

The teacher can also use the tool for creating tests for summative evaluation of knowledge. The test may be part of a learning object or self-dependent and can be used for self-evaluation or external evaluation of knowledge. However, various types of questions can be used for creation of tests: one-choice, multiple-choice, gap-fill and open questions. There are many options that can be selected for a test. The author can set parameters on which the test will be evaluated. The students get marks from the system instantly and can see the correct answers. Furthermore, for test creation we can also use Hot Potatoes or other open source applications that produce output in SCORM format.
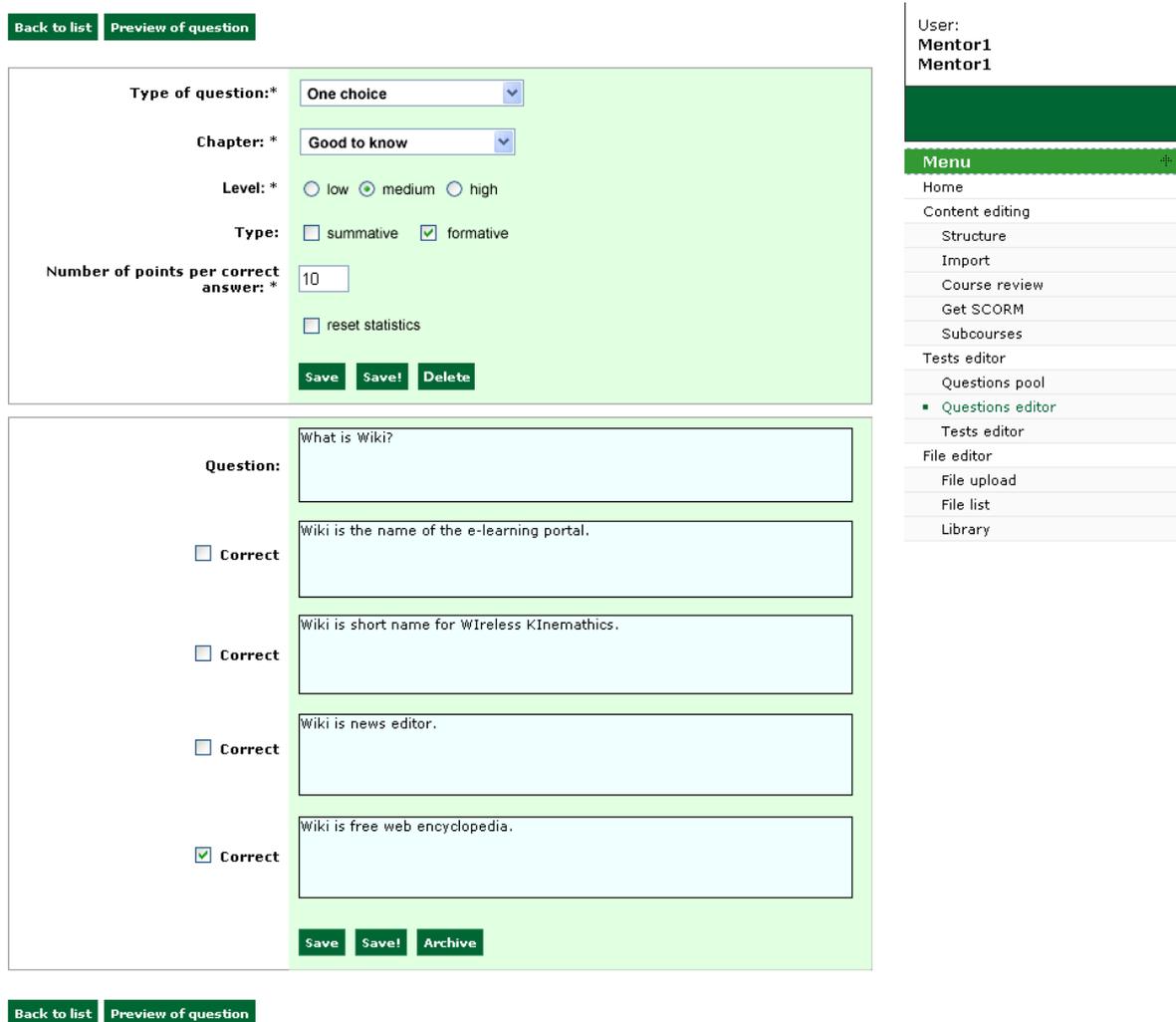
Fig. 3

Learning contents, that are part of the course enable students to achieve basic skills. After adopting basics, students can work on various assignments. The feedback can be provided by the teacher and by the peers using forums.

Various tools are used to assess the process, contents and the system. Errors in the system or in the learning contents should be eliminated as soon as they are discovered and students are expected to take part in this process. As they have problems to clearly describe an error or problems with comprehension, the student can send his/her message from a specific learning page. The tutor receives the message as well as the URL address of the web page that caused the problem to the student and forwards it to the right address (e.g. to the author of the content, to the teacher, or to software maintenance staff).

Figure 2 shows how student's can communicate with the teacher or with the tutor from the learning page. The teacher receives the post on his/her mail, together with the URL address of the learning page where the question or comment was created. As can be seen in the data collected by the portal, less than 10% students have ever used this opportunity. Data from the questionnaires show that most of the students were not acquainted with this option.

3.2   Feedback tools for teachers and the school

eCampus furthermore supports design of questionnaires and opinion polls that are created in the form of scaled answers (e.g. 5-point Lickert scale), one-choice or multiple-choice answers and answers to open questions, to obtain users' opinions and satisfaction.

As self-evaluation is an important principle of learner centred and user centred design, assessment tools are essential in LMS systems. Therefore, in eCampus some innovative and effective solutions are implemented to enable
–   efficient learning,
–   permanent improvement of courses and
–   constant development of the system

3.3   Research

Participants
We observed 52 students from vocational high school in blended learning mode of delivery in our research.

The procedure
All participants studied *Business mathematics* course and followed the same scheme of the learning process. They started with a conventional lesson in classroom where they met the teacher and continued the learning-process using the web-based learning contents on the learning portal, powered by eCampus, which enabled them to collaborate and communicate with each other and with the teacher. The teacher guided students and motivated them to take part in the assessments.
The results were captured by means of an online questionnaire. We analysed the results of the students' responses obtained from questionnaires.

Results

Statement about knowledge evaluation	Agree	Undecided	Disagree
Online questions increase learning motivation	85%	15%	0%
Each learning page should have interactive question	73 %	21 %	6 %
I answer the online questions	73%	23%	4%
Online tests increase learning motivation	71%	21%	8%
Online test are appropriate	85%	13%	2%
Each learning content should have a test in the end	85%	15%	0%
I read posts in forums even if it not obligatory	37%	28%	35%
I write posts in forums even if it not obligatory	13%	19%	67%

Students found online questions and implemented tests very effective and important for their motivation. They were also satisfied with the tests. Unfortunately, most of them participate in forum debates if they have to.

4   Conclusion

Provision of feedback to students is one of the essential features of a LMS system. The authors of the e-courses and e-contents use it to enforce learning and to increase the learning outcomes of their students.
The system has to provide tools for creating feedback and the authors use them for creating efficient learning materials. Automated feedback, generated by the system, as well as partially automated feedback, where tutors or teachers are engaged in its creation, represent substitution for live interaction in the traditional classroom.
On the other hand, feedback on learning materials and on the process of learning from students can be captured by the system. It is very importrant for tutors, authors of learning materials and for the institution running a course in order to improve both, the learning materials and the process of learning.

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