

Intelligent support of web-based knowledge assessment system

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Abstract

The concept and possibilities of Intelligent support of Computer Assisted Assessment (CAA) for higher levels of understanding (according to six cognitive categories – recall, comprehension, application, analysis, synthesis and evaluation) are presented. A point of view on testing types: a case of graphical construct question is discussed. Implementation possibilities of intelligent control of cognition process through knowledge-based assessment system for studies in higher education are presented.

1. Introduction

In most cases the web-based network learning supporting services are widely used for delivery of entire courses to remote learners. According to our approach to network-based education, network services and software tools are primarily being used not only for delivery of entire courses but as enhancements of classroom based education with pedagogically effective materials and flexible learning process control [1,2]. Along with basic WWW services for content design and delivery, standard and/or proprietary software tools are being used to support and improve the web-based individualized self-instructional mode of learning, grounded on the constructivist model of education. One such tool is the TestTool, which has been developed at Computer Network Dept. carrying out INCO-Copernicus project MATEN (Multimedia Applications for Telematic Educational Networks) [1,2].

2. The improvement of Computer-Assisted Assessment tools

Computer-Assisted Assessment (CAA) testing is being increasingly used in higher education institutions. Meanwhile, courses offered in our university belong for science and engineering. Typically for subjects of this kind process or construction understanding is needed. Engineering studies are based on knowledge building via real understanding how process or construction works as a whole. This real understanding must be achieved

through accumulating subject knowledge base as well as through developing skills. CAA environments currently in use help mainly to assess level of knowledge, but have limited skills testing possibilities and authors face difficulties when skills assessing is required. Much more important question is does the assessment engine supports pedagogically meaningful assessment situations, does it allows to construct authentic situations with fewer restrictions on students' actions. From our point of view, the TestTool demonstrates the attempt to design such an assessment engine.

The TestTool assessment engine along with traditional types of questions includes a new question type addressed to assess real problem understanding rather than recalling and looking for correct answer among a few predefined alternatives. We call this type of question as 'graphical construct' [2]. The concept of the 'graphical construct' question is in giving a student the task to create or assemble a correct construction from a set of objects spread in constrained area on the screen, called a 'graphical panel'. The content of a test question in this case is to build up a correct construction from the objects given, avoiding a selection of the correct answer from the predefined ones. Behind the scene there is a fully correct construct created by the subject author, which is used by assessment engine when student submits his answer version.

Actually the idea itself to do so is not new, but its implementation in practice is much more difficult and more expensive if compare with implementation of Multiple Choice Question using HTML, CGI, Java scripts or any other web application programming interface. A programmer having a task to implement the concept of the graphical construct question actually must find out a compromise between realizability and meaningfulness of test situation. In other words, it is a trade-off between meaningfulness of the test question and possibility to check automatically the correctness of the answer to it.

Further efforts in using and development of the TestTool are aimed at improvement of both methodological and technological basis for preparation of good questions, also looking for relevant subjects. In general, network capabilities such as web-based course delivery, access to external resources, educational multimedia as well as on-line assessment provide

potential advantages to develop pedagogically effective learning materials. The appropriate technology mechanisms to accommodate constructivist learner-centered style of assessment have been used when implementing TestTool. The system has a reasonable degree of security – users are authenticated, there are no HTML pages stored on the server, test sequences are generated on the fly from data structures saved on the server.

3. The active knowledge acquisition via Intelligent support of CAA

The ideal behavior CAA for knowledge based learning process control is required to be similar to that of human tutor [3]. The idea of this research is that education is considered as active knowledge acquisition process. Analysis of human mentality mechanisms, which are used in knowledge acquisition, may help to determine nature and investigate effective learning methods. A range of research in cognitive psychology indicates that people are active and constructive in their learning [3, 4]. So, they view the learner as an active participant in knowledge acquisition process who selects and transforms information, constructs hypotheses and alters these hypotheses. Learner-computer contact need not be reduced to the passive use of existing tutoring program only. On the other hand, CAA as a tool must ensure implementation of two main features of flexible learning: to provide students with the opportunity to take greater responsibility for their own learning and to enable students to be engaged in learning activities and opportunities that meet their own needs [4]. Moreover, it must ensure tutoring flexibility for teachers. The purpose of flexible intelligent education is achieved by making references to human tutor's desired characteristics and simulating natural knowledge acquisition process. The conceptual structure of the Intelligent CAA consists of the four types of knowledge based components. They are problem-solving expertise, student model, tutoring strategies and the model of natural interaction process student-computer [4].

Our approach is based on developing Flexible Intelligent Learning (FIL) environment with abilities to a particular student [4] and ability to realize various tutoring instructions relevant to desirable teaching strategies. It provides the environment that engages and encourages active exploration and learning, forms good technological skills and/or better process understanding. So, the FIL environment can be rather different from the standpoint of learning strategy and subject complexity. The easiest way to implement management for tutoring and knowledge assessment process according to the results of the individual learning course is when the

system summarizes results of exercises done by the student and selects themes to be learned for him. The teacher can only change students' knowledge level evaluation requirements. It was implemented a simple enough but flexible and effective enough adaptive management for learning process in several computerized tutoring courses. This management takes into account individual learning results and allows expanding management mechanism with new elements according to learning from mistakes and student's psychophysical abilities.

Intelligent TestTool support was carried out using agent based software technology. The usability test has been done in real teaching setting when delivering "Data Structures" course module for CS undergraduates [1,2]. Students reaction were expressed by communication between students and tutor as a feedback using of WWW discussion board and e-mail. In general, students' remarks were positive.

4. Conclusions

The presented CAA TestTool version is oriented to realize various tutoring instructions to desirable teaching strategies. The goal of the Intelligent support of CAA implementation is to achieve higher levels of understanding (according to six cognitive categories – recall, comprehension, application, analysis, synthesis and evaluation). The TestTool assessment engine along with traditional types of questions includes a new question type addressed to assess real problem understanding rather than recalling and looking for correct answer among a few predefined alternatives. Intelligent TestTool support was carried out using specific agent based software technology. The usability test has been done in real teaching setting when delivering "Data Structures" course module for CS undergraduates [1,2]. Students reaction were expressed by communication between students and tutor as a feedback using of WWW discussion board and e-mail.

5. References

- [1] Baniulis K., Ciapas B., Reklaitis V., "TestTool: Web-Based Automated Tracing and Grading System", *Proc. of 3-th International Workshop ICL2000*, Kassel university press, Villach, 2000, p.p. 1-7.
- [2] Baniulis K., Reklaitis V., Stuopys E., "Interactive multimedia authoring tool for web-based testing", *Proc. of World Conference ED-MEDIA 2001*, Tampere, 2001, pp. 84-85.
- [3] Mayer R.E. *Thinking, Problem Solving, Cognition*, W.H.Freeman&Company, New York, 1992.
- [4] Baniulis K., Tamulynas B. "Flexible Learning in an Intelligent Tutoring Environment", *New Media and Telematic Technologies for Education in Eastern European Countries*, Twente University Press, Enschede, 1997, pp. 395-409.