Simulation of Computer Adaptive Learning and Improved Algorithm of Pyramidal Testing

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Abstract
In this paper the implementation of computer adaptive testing using mathematical-statistical tools of Item Response Theory is considered. It is aimed for knowledge level quick determination of full-time students and distance learning students to identify gaps in their knowledge. The goal of computer adaptive testing is the student knowledge assessment. There are made commendations for adaptive learning system to individual learning path construction. Such system can be used in within LMS as well as for students self-training.

Existing Methods of Computer Adaptive Testing
The main disadvantage of the classical tests is a fixed number of questions where a student must answer all questions and spend a significant time. For overcoming of this one the computer adaptive testing (CAT) is used, which has a possibility of adaptation to student’s needs and to their knowledge level. During test passing the student’s model is filled.

The Proposed Model of Adaptive Testing
Authors proposed to combine the question in thematic blocks with an odd item’s number, for example three or five to determine the majority of correct or incorrect answers. At the majority of wrong answers student moves to a lower level of question’s difficulty and in case of all wrong answers – two levels down. With the majority of correct answers student is moving to higher difficulty level and at all correct answers he moves two levels up. This will improve the student’s motivation with a high knowledge level, because they will see that adaptive system properly assess their high knowledge level and gives them the difficult questions. For "bad" students the motivation is increased in the case of correct answers to the question, although the question is easy.

Experiments
There were 24 students tested on 40 test questions of subject “Algorithmic and Programming” within Computer Science Curricula, which were used to determine the difficulty of test questions. For the procession convenience answers during processing were sorted by difficulty, and results was ordered by grades. The experiment used a pyramidal testing, classical testing and improved algorithm of pyramidal testing. The duration of classical test was 1052 s, pyramidal test ~ 438 s, and the improved algorithm pyramidal test ~ 332 s. Designed algorithm of adaptive learning system is implemented as a plug-in for LMS Moodle. This plugin provides student registration before learning of educational material, then the system checks student’s enrollment on the selected course, and student’s data are recorded into the model. During adaptive testing student’s model is filled with test results, items list and learning objects difficulties, and the time spent on each response.

Conclusion
Improved algorithm of pyramidal testing is proposed. and it’s implemented as a plug-in for LMS Moodle. There are taken into account the items of difficulty as well as tests are adapted to the student’s needs. As a result the students’ motivation is increased, and the duration of adaptive tests is reduces in about 25%.