

E-LEARNING REALISED BY E-TESTING

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Abstract: In this paper we introduce an e-Learning upgrade to the current system for online computer-based testing, applied at the PMF Institute of Informatics. This upgrade offers a possibility for the students to attend the lectures online during the school year and at the same time possibility to check their knowledge. The system is build on a well structured organization of the testing questions. It is tree organization with multilevel relations between the database elements. The students are classified according to their study area, and they can attend the lectures only for the subjects they are subscribed to.

After attending single lecture, in order to pass to the next one, students have to pass through a test which will show if they have obtained the knowledge from that lecture. The organization of the testing questions implements random positioning of the possible answers that gives possibility not to correlate the question with the answer position instead of learning the essence of the task.

Keywords: Application Service Providers, Internet Service Providers

1. Introduction

In this paper we report development of concepts and software for online attending courses realized through computer-based testing as base for electronic testing system at the Institute of Informatics, Faculty of Natural Sciences and Mathematics, University "Ss. Cyril and Methodius" Skopje. [2,3,4]

The idea was to expand the capabilities of the current system for computer-based testing, and make a system, which will help tracking the students activities during the time of the course. This system should allow the students to attend lectures. At the same time it will allow them to check their knowledge of current lecture before going to the next one. The final aim of this software will be to integrate some kind of intelligence, which will lead the student in the process of learning, depending on ones abilities.

2. Motivation and definition

We will present the ideas that motivated us to upgrade the specialized software for computer-based testing used as general electronic testing system with ability for students to attend courses online. The concept is implemented for big number of students, which requires a lot of efforts from the lecturer. The lecturer has to generate different tests for more groups of students. A lot more effort is required for the lecturer to realize test checking and tracking student results for every lecture during the time of the course.

All online courses known to the authors include structured course material presentation using multimedia and Web technologies [7]. None of the software packages mixes the real learning concepts realized as dialog, interaction to check the obtained knowledge in order to have adaptation of course presentation due to the student's level. Of course this is a very sophisticated learning concept very hard to implement by computer software.

Our motivation was to make this interaction possible and realize online learning by e-Testing. After presentation of course material and lessons, the e-Testing system is started. Each student can check his/her knowledge and go back and forth in the system until knowledge skills are fulfilled. This interaction is very efficient tool and substitutes homework assignments and quizzes given by the lecturer in order to assess student knowledge.

Our primary goal was to help lecturer track student activities during the course, which requires different test generation for every student about each lecture. The test should have different set of questions and be generated for relatively big number of students. The system should generate different test each time the student applies for testing.

The security mechanisms implemented in the current system prevent from memorization of combinations of questions and answers [2,3,4]. Instead, the system forces learning of the concepts i.e. relations between questions and answers. Randomly generated questions with randomly positioned answers are displayed every time the student requires new question.

The current system structure [2,3,4] gives ability to the lecturer to easy reorganize the course materials, including the order of the lectures in the course. This is very important for the upgrade because students start to learn from first lecture and go through lectures one by one. They cannot read materials or make tests for any lecture if they have not read materials and pass tests for the previous lectures.

Besides structure reorganization, the lecturer has the opportunity to generate several types of reports regarding the student activities during the time of the course. The lecturer can see the number of students that applied for attending the course online, and see their activities. He can see statistics for every student regarding

every lecture from the course. The advanced statistics show how successfully the student has passed the specific lecture, which can be helpful in assessment of student knowledge. All collected data can be used with any spreadsheet and statistical packages.

3. Definition and comparison

Computer and Internet WEB technologies and their implementation have very fast development in all types of technologies used nowadays. A lot of authors tried to define the terms concerning the computer-based testing or electronic testing systems. We can count more than 30 producers of software package for distance learning in 2001. In this article we give an overview of definitions for electronic testing systems and computer-based testing.

3.1 Definition of electronic testing system

Authors in [10] locate testing and assessment applications by its development and administering. According to their definition, computer-based tests are defined as tests or assessments that are administered by computer in either stand-alone or networked configuration or by other technology devices linked to the Internet or the World Wide Web.

In [7] the testing is defined as a technology that includes facilities to assist in the making up of practice quizzes, tests, exams, and other assignments. Therefore we conclude that computer-based testing is a method for testing by using computer hardware and software, and define the electronic testing systems as dynamic computer systems that support computer based testing. They include various methods for data base management and artificial intelligence to support decision-making process for generation of testing material. All these activities are realized through WEB based Internet technologies.

We must notice that dynamic computer-based testing can be used not only for distance learning, but also for conventional methods of learning in the means of evaluation of the student's knowledge, assessment and helping the students in the process of learning to better accomplish the knowledge skills and concepts.

3.2 Comparison to the other software products

Online Course Delivery Software Products are very successfully compared as a web tool [7]. We use some of these data to present only computer-based testing as an efficient tool for different purposes like conventional education, not just distance learning or on line-learning software tools, but job-hunting quizzes, interview quizzes etc. It is assumed that nearly all the examined products accom-

plish multiple choice questions, true/false questions, matching questions, short answer and quantitative questions.

A very small number of revised software products supply self test tutorial questions, timed quizzes and generate random set of questions. The following is a list of software products that supply on-line testing. The list is ordered by the number of web based hits [6]: WEB CT, BlackBoard, Learning Space, Top Class, IntraLearn, eCollege.com, Web Course in a Box, Docent, UniLearn, Generation 21, The Learning Manager, EduSystem, Vcampus, Serf, QuestionMark, Digital Trainer, Mentorware, Eloquent, Convene.com, Ucompass, IVLE, Saba Learning Enterprise, InterWise Millennium, Theorix, Embanet and Inspire.

So far, there are no capabilities supplied in our concepts to generate randomized questions, randomized order of answer options, to select from a relatively big question database, to generate a test by defining the strategy to choose questions from selected areas etc. That was our real motivation to produce this type of software.

No Concepts for e-Learning with e-Testing were found in all analyzed software packages. We can conclude that this concept is only realized by software described in this article.

4. Practical implementation

Our software package for online attending courses is realized using ASP (Active Server Pages) as main scripting language, Microsoft SQL server as database server, and Internet Information Server as Web server. The application can be accessed using any Web browser.

Each generated test about specific lecture measures verbal, quantitative and analytical skills related to that lecture. The lecture consists of a set of questions defining one concept or one knowledge skill and different time constraint is associated to each lecture. We differ three classes of questions: verbal, quantitative and analytical questions, similar to the description in [5].

60 seconds are usually associated to lectures that consists of verbal questions which defines a specific concept or definition. 240 seconds are associated to lectures where a specific quantitative measure is expected to be calculated, or more sophisticated concept to be explained, and up to 10 minutes are associated in questions where a specific quantitative measure is expected to be calculated, or more sophisticated concept to be explained. [2,3,4]

As we have mentioned, the application has fully WEB based Internet operational module. The first page that is displayed to the users is log-in page where the user is recognized as student or lecturer, depending on what different menu page is displayed. The page for students consists of several options they can choose

from. Among typical options are: self-testing option, exam option, report option and online attending courses option. The lecturer's page allows them to choose among several options like data entry tool, the tool for question database editing and organization, tool for test and exam definition and report tool.

In the online attending course section, the student can choose a course for which he wants to attend lectures online. List of courses, which are available for online attending, are displayed to every student on its main page. After choosing the course, the student has to subscribe in order the system to create record for him. Once the student press a button he is automatically subscribed and a record about that student is being created. The lecturer immediately knows which students are subscribed and can view their records.

When a record for student is created, the student can view the tree structure of the course, and he is pointed to start with the first lecture. For every lecture there are two options: link to the presentation materials for that lecture and link for generation of test for that lecture. The student can read materials about the lecture and once he/she decides to check the knowledge of that lecture, he can take test which will evaluate its knowledge about the particular lecture.

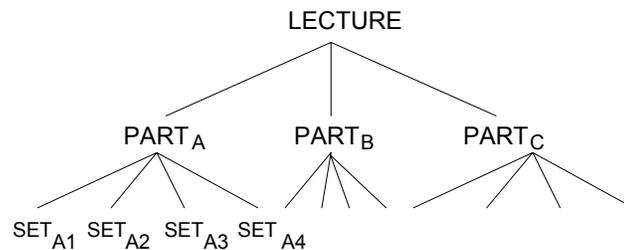


Figure 1: Tree like organization of the lectures

A tree like organization of lectures is implemented. Each lecture consists of smaller parts and each part consists of different sets, as shown in Fig.1.

The course material in the lesson is divided in at least three parts (in Fig.1 marked as A,B and C) For each part there are at least 4 sets of questions. Each set of questions consists of at least 5 questions. At least one of these questions is hidden and is intended for final test exam, not for testing purposes. The remaining questions are candidates for online testing. The different sets of questions are leaves in the tree organization (Fig.1). When the student decides to check his knowledge he starts with the left most node in the tree. Then the system selects questions from the candidates in the given set. The questions are asked one by one in segmental order. After the student finishes the strategy to pass the given set of questions, he is allowed to go on the next set. The nodes are traversed in preorder i.e. L-R-O, that means that all the sets from a given part has to be passed

and then the final test for a given part is generated. Then the next part is traversed until complete lecture is fulfilled and test is generated for the given lecture.

The current strategy to pass a set of questions in the system is 3 correct answers in a row. If the student answer is not correct, the counter for correct answers in a row is reset. The questions are repeatedly selected in random order from the candidates. In the database there is a track of the efficiency of the tests the student takes. The lecturer can see how many questions the student answered before answering three correct in a row.

These sessions can be carried in informal atmosphere and students are allowed to talk freely or refer to notes. The online attending course procedure is a realization of web-based testing that offers 24-hour access to testing and materials with the e-Business concept anytime, anywhere.

There are two types of tests based on procedure of continuing when a given answer is obtained for a given question, adaptive and nonadaptive. The types of tests we use in testing part of online attending courses option are adaptive tests. That means that generation of new question is related upon the correctness of the answer for the given question.

The current version of the system we have developed which is a base for this upgrade consists of also nonadaptive tests since these tests can be used efficiently for computer-based assessment. [2,3,4]

We have pointed that the student gets one question by another in a row, since they have to answer correctly three questions in a row to pass given set. The question is answered correctly when all possible correct options are checked.

In the case of multi-choice questions the student can answer one up to all possibilities of given answer options. The addition to this strategy is that no question has all correct answer options and there must be at least one incorrect answer option.

The current system has few question types. Multiple-choice questions, true/false questions, short answers and quantitative question are types of questions implemented in the tests generated when students are checking their knowledge about specific lecture. [2,3,4]

The system does not implement an essay possibility of answers since it can be realized whenever student meets the lecturer. The lecturer is reviewing these questions even in the existing software products that realized this type of questions.

Test administrators can efficiently use the report tool to see the student progress, its tests and check his knowledge or absence of specific skills. The lecturers are allowed to see each student log file of activities and the test itself.

5. Results

A real motivation was to discover a strategy to pass different sets of questions. Our research showed best results for the “3 in a row” strategy. We tested plenty of strategies like “try all questions”, “N in a row”, “N correct answers” etc. We concluded “3 correct answers in a row” to be the best both for the students and lecturer. The “try all questions” was not motivating for the students since it does not have elements of fun and entertainment, and also element of computer games the students like. We concluded that the students like challenge, they like competition and that’s how they realized all assessments thinking it is fun [1]. The “N correct answers” strategy was also not motivating since it does not allow freedom, random generation and the element of unexpected the students like. Suppose that the student doesn’t give correct answer to a given question in a given set. Then this strategy repeatedly asks the same question until a correct answer is given. This makes the system a boring place, since the same things happen.

The “3-in-a-row” strategy makes the system interesting. Suppose that the student doesn’t give correct answer to a given question in a given set. Then the counter is reset and another question is randomly asked. The student has another “3-in-a-row” motivation. What this system usually offers is repetition of the questions in random order, although they were correctly answered before. This makes the student really motivated for a good practice and concentration.

The system is interactive with course material since if a wrong answer is obtained the student goes back to the material to learn the concepts and comes back to the system. The “3-in-a-row” strategy also makes a possibility for a luck to have 3 selected questions with known answers, but this is also how the exam exists in the real life.

We have 3 courses with approximately 8 lectures, 30 parts and 150 sets of questions and more that 1000 questions per each course. The online e-learning with e-testing was realized with more than 70% of the questions. Once the students passed this type of online learning they successfully passed the exam without a lot of efforts. It really helped them to fulfill their knowledge.

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