INTERACTIVE LEARNING SYSTEM

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Abstract Interactive Learning Systems can be efficient methods to realize learning process by electronic means. The very big arena of commercial e-Learning products and projects usually do not offer tools for establishing interactive environment in classical classrooms. We offer a solution that consists of interactive system for electronic testing with additional intelligence to support decision making solutions how to upgrade student's knowledge and monitor students' process of learning. This method can be efficiently used for classical environments, where the teacher would like to analyze the response of students' opinion and make corrections or additions to the lectures.

Index terms: e-Education, e-Learning, on-line learning, electronic testing, computer based testing

1   Introduction

E-Learning is a system that helps learning process by electronic means. A very comprehensive survey on e-Learning processes is given in [1] as receptive – information acquisition; directive – response strengthening and guided discovery – knowledge construction.

The development of concepts in educational institutions is always demanding activity on all basic, high and university levels. It requires constant control and development of general concepts for education. A new trend for education in the part of knowledge construction method is organization of interactive learning. Within this process, the contemporary organized lectures should maintain a strong connection with the learning process.

We suggest e-testing as a very useful method to establish intelligent interactive response system. Introduction of interactive response in learning systems means that there is on-line instructor capable to monitor and conduct the learning process and help the knowledge construction process for learning. Recent developments in Information Technology make more sophisticated ideas to be realized in the education process, either in course material presentation of the materials or exam and testing realization.

Usually most of the classes are organized with information acquisition teaching method that uses only memorizing of big quantities of data. In these cases usually the student wants to pass the exam learning only raw data without concepts. This situation results with real catastrophe meaning complete unawareness for the essence of the course materials. The professors usually don't bother in making the classes more interesting for the students and repeat the same classes for years, so the students lose their motivation and interests for understanding the material. Even if some professors devote themselves on making their classes contemporary, interesting and interactive they don't have the possibility to include big number of students. For effective classes the professor needs communicate with all the students, a situation and possibility that classical classes can not offer.

2   Motivation

To ensure active participation in classroom the classes should contain small groups of students. This is practically impossible and inefficient in environments where there is lack of large number of highly qualified lecturers. The professors should also be aware of the level of acceptance and understanding of the material from the students following the lectures. The way of learning and accepting the knowledge should have characteristics of fun and attraction in order to enforce the students to active participation and knowledge acquirement on contrary to their passive physical presence.

The idea to realize on-line intelligent interactive response learning system [5] 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 course. This system should allow the students to attend lectures. At the same time it will allow to check their knowledge of current lecture before going to the next one. This learning system is based on e-Testing system realized at the Institute of Informatics, Faculty of Natural Sciences and Mathematics, University "Sts. Cyril and Methodius" Skopje [3,4]. It is not realized by any similar e-Education programs such as WebCT, or any other known to he authors. Our system offers a model of question definition and test generation; strategy definition and organization; student classification according to their study area; multilevel relations of the areas, courses, students, study areas and exams; enhanced possibility to implement html and other code including more pictures, video, tables and animations. This system also gives the possibility for automatic generation of different tests each time a student applies for.

3   Definitions

This system is based on e-testing. A good overview of definitions for electronic testing systems and computer-based testing is given in [4].

According to definition in [8], 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. A very good definition of testing is realized in [6] as a technology that includes facilities to assist in the making up of practice quizzes, tests, exams, and other assign-

ments. Different authors give various definitions such as: Computer-based testing is a system of testing based on computer usage; PC-based is mainly concerned as stand-alone personal computer testing program and WEB-based testing is a system of testing realized by WEB technologies.

In computer network application the server generates the test. The testing process is realized on a local machine, but, the student's output is usually sent to server for further assessment. Then the server evaluates the result and reports for the quality of the realized test. There are also some modifications of this scheme, for example where the evaluation is also done at the local machine, but usually the server is responsible for test generation, evaluation and report.

While testing cognitive skills and concepts, the tests are usually generated by questions and student output is expected in the testing process. The e-Testing model is realized in such a way that each test generated will measures verbal, quantitative and analytical skills related to a specific field of course study. A different time constraint is associated for the testing process. Four classes of questions can be recognized: verbal, quantitative and analytical questions; and also essays similar to the description in [2], as shown in Fig.1.

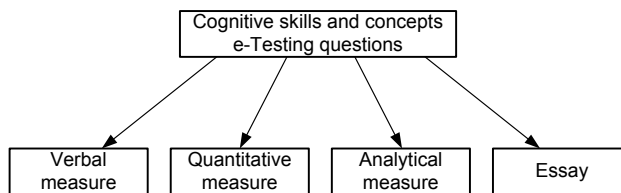

Fig.1: Knowledge based cognitive skills and concepts can implement e-Testing models by four types of questions with: verbal, quantitative and analytical measure or by essay.

For our definition of Interactive Learning Response System we will use only quantitative measure questions. A specific quantitative measure is expected to be calculated or more sophisticated concept to be explained in the case of quantitative questions. In this case usually more mark scores are usually associated to be gained and the time limit is bigger then in the previous case. Basic skills and understanding of elementary concepts, as well as the ability to reason quantitatively and solve problems in a quantitative setting or to explain more sophisticated concepts are tested in the quantitative measure tests.

Another dimension of question classification can include computer software implementation with the following categories: single or multi choice, relation connection, mark entered, numeric value entered and text entered, as presented on Fig.2.
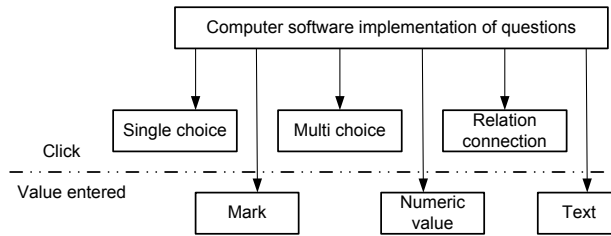
Fig.2: Computer software program implementation can be classified according to the input (mouse click or value entered)

It concerns computer software program implementation, i.e. single choice is realized as radio button object or list choice object in the window; multi choice and mark entered as simple click on special link objects in the window; numeric value and text entered as text box and then processed as strings.

4   Goal

In this paper we present a new method for interactive learning to provide active student participation during lectures and establish permanent communication between the professor and the students. This method uses conventional Web technology and contemporary Wireless and Mobile technologies. A very important issue is to use these technologies for process of acquiring knowledge in course learning objectives. This method is part of complex e-Education project performed at Institute of Informatics, PMF, University SS Cyril and Methodius. It is integrated as ILRS (Interactive Learning Response System) in educational process. The System for Interactive Learning uses electronic media for information exchange by Internet, Wireless and Mobile technologies.

To realize this method during the lesson, the professor can ask questions and get a global snapshot how students understand learning objectives. The professor gets the feedback and realizes how efficient his lecture is; and if the learning objectives and concepts are acquired by the students. This feedback is very useful to repeat appropriate course material to motivate the professor to explain more topics or to give more examples to explain it. It is a very good way the professor to know how the lecture is going on, how much of the learning objectives are acquired by the students, to get idea about tempo and speed of teaching, what to change and how to organize future activities in teaching process to establish better learning. This method also allows the professor to interact with greater number of students in class, for example 100 or 200 instead of 20.

The students use the system for answering the professors' questions. Doing that they show how they understand the course material. Every student that attends the classes is an active participant even in a very large group following the course. His presence and thinking affects the global statistics that the lecturer gets after every question. The system provides the students with the necessary anonymity, so they can freely give their opinion about the questions asked. Generally the system gives the required inter-

activity between the professor and the students, includes all the students in the classes, gives the possibility of adjusting the lessons according the way students accept the material. The main goal of the system is to help students to improve their skills and knowledge faster by interactive learning and to learn from their mistakes. It should provide efficiency in understanding and learning the course material during the classes. It will also eliminate the passive and monotone outlook and make the process of learning easy, interesting and fun for the students. The entertainment character of this method is very important, since the students like games, tease and fun.

5   Functionality

The users of the System for Interactive Learning can be divided in two basic groups: *lecturers* and *students*. The lecturer is the one that creates the lectures and holds the classes and the student is the one that participates and follows the lessons. According to the design and architecture of the system the professor must own a computer with an Internet connection. The system allows students to use different devices for interaction (mobile phones, computers or other). The administrator of the system is the person that maintains the system and is responsible for its correct functionality and security.

This system motivates the lecturer for creativity. He/she can choose the right questions that will help students to acquire the learning objectives and concepts. The next step after question creation is to activate the IRLS system for the class. This can be achieved by activating the appropriate lesson.

The functionality of the new teaching system is the follows. First the instructor explains some relevant concepts and learning objectives. Then he/she uses previously defined questions to check the students' knowledge or acceptance of the new paradigm. The system allows only one question to be asked by setting it as active. Then the students can answer it until the moment the instructor deactivates the possibility to answer the question. Later the lecturer can see the results and get a clear picture of the acceptance level how students understood the learning objective. Then the instructor can decide what was necessary to be explained or how to explain the concepts. In case there is a need to explain concepts once again usually finishes by verification which is realized by asking the same question after a brief discussion.

The instructor can use all the features of the system and control the tempo the knowledge is acquired by the students. It leads to a very efficient system of successful accepting and understanding the material from the students.

6   IRLS System Architecture

The system for Interactive Learning is realized both as a Web based application and as a Web service. This allows users to access the system by different devices for interaction. It provides the users with the possibility to choose whether to use a computer, mobile phone or any other wireless connected device. The architecture of the system is presented in Fig.3.
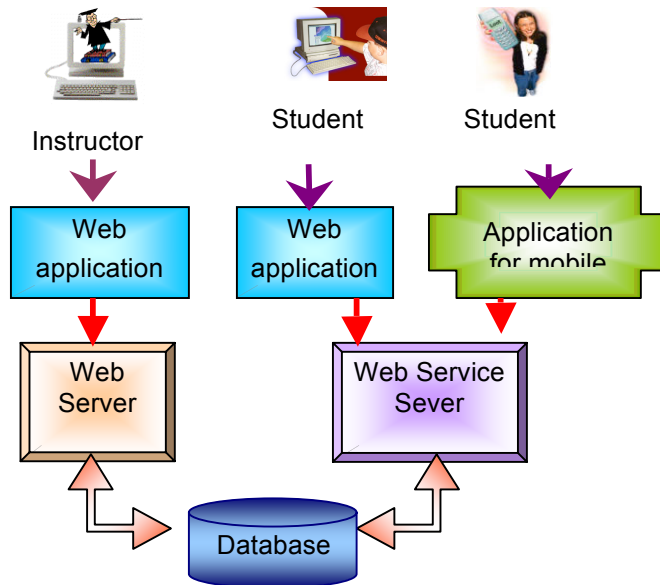
Fig.3: Architecture of the IRLS system

The system is realized as three layer architecture. Main reason to realize this system not as classic client server application is the characteristic of Web applications to be installed on one computer and used on any computer on Internet through common web browser. This is very convenient for students since they are not obliged to come at university to use the system, and can efficiently use e-business paradigm anytime, anywhere. A good survey of Internet as Business Infrastructure and also for e-Testing system can be found in [7].

The three layered architecture is shown on Fig.4, realized by separate database layer, application layer for basic system modules and user interface layer. The user interface layer is connected with the layer of basic system modules where the applications are stored. This system makes different users to be serviced, like Internet web clients, or mobile and wireless devices etc.

The application layer consists of Internet Information Server web server set on Microsoft Windows 2000 operating system. It uses ASP and JSP scripting languages. This layer accepts user interface requests and responds back. It communicates with the database layer based on SQL Server 2000.

Security is very important issue and encryption is integrated in the system with modules to establish authentication, authorization, archiving, privacy, integrity, availability, and unrepudiation.
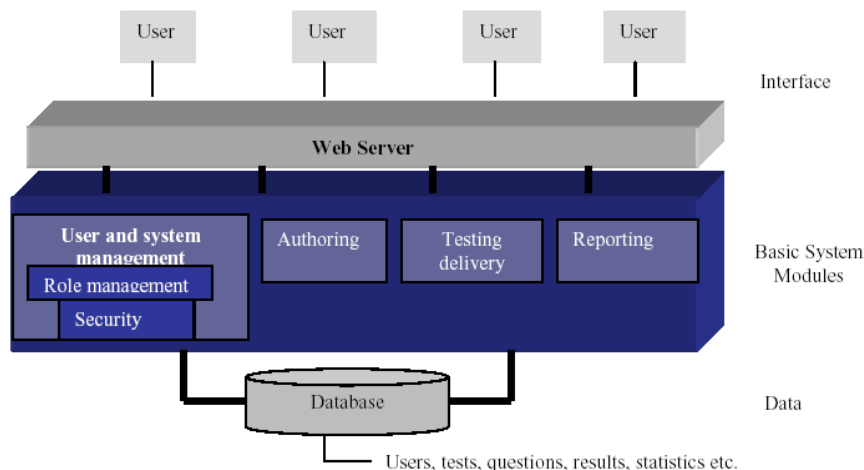
Fig.4: Three layered architecture with database layer, application layer for basic system modules and user interface layer.

Along with the security system there are many methods that prevent cheating, like time constraints, preventing memorization with random generation of questions and random position of the options to be answered, negative scoring for wrong answers, etc. [4].

7   Technical implementation details

The user interface level for the lecturer is bounded with the level of the application logic and serves to send requests from the instructor to the server which communicates with the database placed at the third level. A client can be any device with built Web browser. The application logic includes Web server that contains the code realized using ASP and Java Script. The level of the application logic accepts the requests from the clients (the lecturers), generates the corresponding answers and sends them back to the clients.

The user interface level for the student is bounded with the application logic level and serves to sending requests from the student to the Web service server. The server communicates with the database.

We choose the J2ME platform since it can deliver the power and benefits of Java technology tailored for consumer and embedded devices — including a flexible user interface, robust security model, broad range of built-in network protocols, and support for networked and disconnected applications. This is the platform designed for consumer and embedded devices such as mobile phones, PDAs, TV set-top boxes, in-vehicle telemetric systems, and a broad range of embedded devices.

Web-Applications have distributed and service-oriented architecture. Web service is a software application that can be accessed remotely using different XML-based languages. It is an application that executes a completely specified task (or tasks) and

can be accessed from "anywhere". The difference between the Web sites and the Web services is in the type of interaction that they can provide. The context that the client sends to the Web service is an XML document formatted in a special way in accordance with the SOAP (Simple Object Access Protocol) specification.

The Web service is constructed with one Web server and more clients using that server. The Web service server is implemented with the programming language Java. The users can use the clients implemented with J2ME and ASP with JavaScript. The students can participate in the interactive classes using the system with Web pages or mobile phones. Crucial moment is to see the universality of the Web services. Client-applications for different devices can be made by using the WSDL document. The communication between the server and the clients is of the type *request/response*.

The essential step in the process of designing the Web services are the messages. The messages used for the communication between the Web service and the clients are strings. The service implements four methods that the client can call with the proper parameters. The methods are used to generate the list of courses that have active lecture at that moment, to generate the identification number of the active question, its text and the possible answers; to generate the numbers of the options that the student choose and to register the answer; and to generate the number of the students that answered the activated question correctly, incorrectly, and the numbers that give the information on how many times each option of the answers is chosen by the students.

The methods are called with string parameters that use delimiters. Two client applications are created. The client applications call the specified methods from the Web service and use the information they get for displaying the required data. The ASP client uses Web pages for that data and the J2ME client uses mobile phones for interaction with the user. There is a possibility for designing another client application that will use different devices for interacting with the Web service. The Web service server and its methods remain the same.

8   Results

The participation of the students is very active by using the IRLS system. They found this system very interesting. It allows fun and entertainment to follow the learning process and accept the learning objectives by interactive answering questions. The system provides the necessary anonymity and the students can freely give their opinion and participate in the global statistics that give the picture of how the material was understood from the whole group following the lesson. Following these interactive lessons the students have the possibility of understanding and learning the concepts and learning objectives during the classes. From one side this system provides faster knowledge acquirement and construction and from the other side it allows greater quantity and better quality of the knowledge and skills.

9   Conclusion

The Interactive Learning Response System represents contemporary organized lectures that maintain a strong connection with the learning process. The professor asks questions and according to the feedback from the students realizes how efficient his lecture is and if the learning objectives of the course material are acquired by the students. This method allows the professor to interact with greater number of students following the course. The main goal of the system is to help students to improve their skills and knowledge faster by interactive learning, learn from their mistakes and make the process of learning interesting and fun. The System for Interactive Learning with the ILRS can be used as a platform for future development on complete e-learning system in order to improve the process of education in the institutions where it will be accepted and used.

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