Intelligent e-Learning Framework for Practicing Educational Testing Services

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Abstract: *This paper presents conceptual framework architecture of an e-Learning system that could be used to prepare students for an educational testing service like exam. The preparation process consists of two main activities that will be conducted in a distant learning environment: completing interactive learning activities based on subject materials and conducting a set online sample tests. The architecture employs intelligent software agents to facilitate the personalization of learning objects to be presented to each student. The system will be deployed using the web services platform, allowing access through personal computers, mobile devices and PDAs. The main objective of the system is to provide learners with more flexibility and to reduce their preparation time for the ETS exam by allowing them to navigate through materials and exam based on their academic profile from various access points. The architecture will be fully implemented by the Applied Science University in Jordan to be used by their graduating students in their preparation for setting the educational testing services exam. It will replace the current traditional way where students need to set in certain dates to conduct educational testing services tutorial sessions and paper-based exams.*

Keywords: *Intelligent e-learning, web service e-learning and mobile e-learning.*

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1. Introduction

The Ministry of Higher Education in Jordan requires all Jordanian graduating students from their BS/BA degree to take an ETS-like exam during their last semester. This exam is critical to maintain the quality of higher education among competing private and public universities. To prepare students for the exam, universities normally conduct extra sessions of lectures on material related to the exam subject matters. This put extra burden on both instructors and students. Instructors need to prepare and deliver reviewing sessions along with exam materials which cases an extra load on their already packed schedule. Students also come under extensive pressure to do well in these exams where they may sacrifice studying time that should be otherwise dedicated for their regular courses. Also, some of the students may require more extensive preparation than others in some area where no regular courses were taken previously during their course of study. In addition, students need to set in a certain dates to conducts ETS assessment exam. The current exam feedback method is very limited in providing students with valuable information on their weakness and strength. Further complication arise from the need to provide access both on campus and outside, as well from desktop or mobile devices [5].

2. Major Questions Addressed

Given this background, the major questions addressed by this framework are:

1. How to use Intelligent Software Agents (ISA) [2] in customizing student progress to optimize their performance.
2. How to implement online tutorial sessions by applying proper learning designs [□].
3. How to map both learning items and questions items within a single learning objects repository.
4. How to use of web service technologies [3] to allow maximum flexibility access from any place, reflecting the technology of ubiquitous computing.
5. How to properly present learning materials and questions on various platform such as desktop computers, PDAs, etc.

How to allow several feedback mechanisms for better information utilization.

3. General Process and Conceptual Framework

The general process consists of the following steps:

1. ISA will be initialized using student background such as cumulative grade point average, number of hours per semester, major, elective course, and warnings.

2. Based on this background, the system provides suggested material to review or proceed directly to test taking. Students may override this suggestion.
3. Learning material will be assembled by reusing the existing Power Point-based materials which could be imported in a third party application (such as Breeze [1] or LAMS [4]) to produce an interactive learning sessions based on a proper learning design .
4. Students either go through the material, or proceed directly to exam taking. In the first scenario, students take the sample exam if they pass the material review, else they will repeat the review of the material until they do so.
5. After each session, ISAs will be updated with test results and questions taken for each of the material. This history of exam preparation activities should assist ISAs in suggesting courses of actions on future access, such as recommending material for review or exams to take.
6. Upon each request to access system resources, the system will determine whether to display questions and material on a desktop, Mobile, or PDA screen.
7. Throughout access sessions, students are allowed to give instant feedback to the system on the proposed material, questions, and/or user interface.

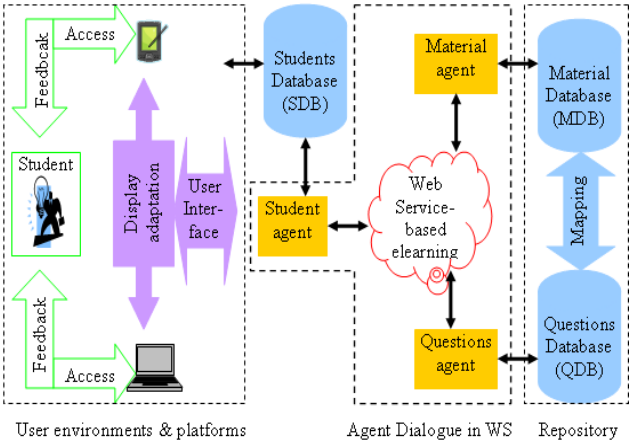

Figure 1. An architecture of intelligent elearning system.

The above Figure represents the conceptual architecture of the proposed framework.

4. Implementation Techniques and Procedures

Based on Figure 1, the following procedures and technologies are employed in developing the system. For ease of classification and discussion, three major components are identified in the Figure. These are discussed below from right to left:

1. Databases repository: three databases are included: material database and questions database.
   a. Material database: PowerPoint slides are developed with Breeze plug-in component to assist in incorporating multimedia with PowerPoint presentation to assemble a single topic tutorial session. The topic's slides will be organized by a classification hierarchy (Class ID, Topic ID, Perquisites, etc.,) similar to the questions database to permit the mapping of the two databases. For each topic, students can review a sequence of multimedia slides that is coordinated by a set of close-end questions (MCQ, YES/No, etc.,)
   b. Questions database: the question database is organized majors and according to areas and their respective topics provided by the Ministry of Higher Education (MoHE) in Jordan. The number of questions in each area will also reflect the percentage assigned to each area. Questions are classified into three levels: easy, average, and difficult. The backend database management system is MS SQL using .NET platform. The MS SQL allows publishing applications as native Web Services (WS) on the Internet, meeting another requirement of the system to be WS-enabled. Both databases are mapped together to allow dynamic access of material and questions based on the recommendations of student software agent.
   c. Students Database: this database will contain relational data of all students taking the ETS exam. It will interact with student agent and the user environments and platform components.
2. Software agents and dialogue: the system deploys three software agents representing students, questions database, and material database. They interact over the Internet to achieve an effective and efficient access by students and feedback to them as well. The three agents will be initialized by essential data and information, such as student's name, major, GPA for the student agent, and meta data on the characteristics of the material database and questions database. Based on historical performance both post material review and test taking, certain intelligent component allows customized material and questions to be retrieval by students and devise future course of action on how student should proceed in subsequence stages.
3. User environments and platform:
   a. User Interface (UI): the system uses two types of UI: a multimedia-based PowerPoint presentation and text-based multiple choice questions. The display design should assign a specific area on the screen for text-based feedback following material review and question answering.
   b. Displaying adaptation: the system should automatically detect hardware platform to be used by student to access the system: either desktop or

PDA screens. Subsequently, the system executes a program to format the UI accordingly.

c. Access and feedback mechanisms: the UI allows two main types of feedback: during material review and testing and post material and test taking sessions. The feedback mechanism works both ways: from system to student and vise versa. For example, students are allowed to record comments on material and question validity and relevance, suggestions to improve the material and questions databases, and recommendations to improve the UI. On the other hand, the system report back to students, as a result of posterior analysis, areas of strength and weaknesses, recommends material to be reviewed and/or tests to be taken, and, finally, overall evaluation of the student's performance at the end of the preparation and testing period. As for in-flight (during session) feedback, students receive comments of material reviewed and questions answered incorrectly.

As to programming language, the ASP.NET environment is used to develop all components, such as user interface, display adaptation, and software agents.

5. Major Points or Results

The following are major points resulting from using such system:

- Anyplace/anytime access: students can prepare for the exam by reviewing the material and taking the mock tests from different locations, such as on campus or off campus; and using different hardware platforms, such as desktop, laptop, or PDA. This is very important because students are pressed for time during their last semester, especially in developing their senior graduating project.
- Faculty-related issues: instructors need not to be present at lecture rooms in specific time. More importantly, instructor will be encouraged to prepare the material in PowerPoint format prior to delivery.
- Students' feedback issues: by conducting the training process anonymously, students are encouraged to give feedback more frankly and openly.
- System's feedback issues: by incorporating certain intelligent component, communication among the three software agents will generate customizable feedback to students.

6. Conclusions

Several implications are highlighted below:

1. Better preparation: through the customization feedback, students can skip material which are they strong in and concentrate of material that they are weak in.
2. Quality of system: students' feedback should lead to improving system quality for both material and question databases, as well as the user interface. Further usability engineering studies may be conducted to ensure that the system meet minimum requirements for all of its components.
3. Maintainability of system: with the computerized system, questions and material databases could be updated easily and mock tests could be re-generated on the fly. System maintenance may include fine tuning questions, adding new questions to reflect new and current development in information technologies, deleting outdated questions. This aspect is so critical with the fast paced development that characterizes information technologies.
4. Savings in preparation time: with selective access of material and questions databases, students can reduce preparation time. This may lead to increasing student psychological satisfaction and improved students performance in the real exam, as well as pass positive feedback to prospective students.
5. System verification: through the use of system development prototypes, students and faculty can get involved in the development process, allowing system verification (building the system right) during the development processes.
6. System validation: with usage data, several statistical analysis can be employed to validate the system (developed the right system). This may include comparing different platforms to students' performance in the real exam, and comparing students who actually used the automated system against those who did not vs. students' performance in the real exam.
7. Documenting lessons learned: in a posterior analysis of system development and usage activities, a knowledge-based system can be developed for future reference

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References

[1] Adobe, http://www.adobe.com/ products/breeze /index.html, Last Visited 2010.

[2] Bouras C., Triantafillou V., and Tsiatsos T., “A Framework for Intelligent Virtual Training Environment: the Steps from Specification to

Design," *Educational Technology and Society*, vol. 5, no. 4, pp. 11-2□, 2002.
[3] Derntl M. and Mangler J., "Web Services for Blended Learning Patterns," *in Proceedings of the IEEE International Conference on Advanced Learning Technologies*, Finland, pp. □14-□18, 2004.
[4] LAMS, "The Learning Activity Management System," http://www.lamsinternational.com, Last visited 2010.
[5] Laurillard D., "Design Tools for E-learning," *in Proceedings of the 19th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education*, NewZealand, pp. 4-5, 2002.
[□] Tattersall C. and Koper R., "EML and IMS Learning Design: from LO to LA," http://hdl.handle.net/1820/107, Last Visited 2004.

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