QUEST - An Assessment Tool for Web-Based Learning

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Abstract: The Internet has great potential for educational purposes. In 1997, the Software Engineering Laboratory at PUC-Rio implemented a first version of AulaNet™, a web-based educational environment. This year, some of the teaching staff will be using this environment to offer regular term disciplines through the Web. This paper introduces Quest, the quiz generator and assessment tool incorporated into AulaNet™ to provide the means to support educational assessment through the Web.

Keywords: Web-based learning, learningware, quizzes, distance education

Resumo: Com o rápido crescimento da Internet, a Web se tornou um meio poderoso, global, interativo e dinâmico de compartilhamento de informações. A Web oferece uma oportunidade de se desenvolver novas experiências educacionais para os alunos. Os recursos da Web são utilizados para criar um ambiente onde o aprendizado é promovido ativamente. Este trabalho apresenta o Quest, uma ferramenta de avaliação educaional para a Web, que é o módulo de avaliação dos aprendizes do sistema AulaNet. O Quest tem o objetivo de determinar os resultados finais do processo de aprendizado, isto é, os processos e os produtos que descrevem a natureza e a extensão do aprendizado, seu grau de correspondência com os objetivos da instrução e sua relação com o ambiente de aprendizado.

Palavras-chave: Educação baseada na Web, learningware, avaliação, educação a distância

1. Introduction

With the fast emerging of the Internet, the Web has become an increasingly interactive and dynamic medium for sharing information. The Web provides an opportunity to develop new learning experiences for the students not possible previously [Alexander, 1995]. It has been increasingly popular to move away from the traditional model of education and move towards a more interactive, computerized system [Carbone and Schendzielorz, 1997].

AulaNet™ is a project in development at the Software Engineering Laboratory (LES) to deploy an environment for the creation and maintenance of Web-based courses designed for the layman. The objectives of AulaNet™ are to adopt the Web as an educational environment; to foster a workable transition from conventional classrooms to virtual classrooms, giving the opportunity to reuse the existing educational material; and to create knowledge communities [Lucena et. al., 1997].

Quest is a quiz generator and assessment tool incorporated into the core package of facilities provided by AulaNet™. It would be desirable for an interactive Web-based learning environment to have a Web-based way of assessing the students, instead of using a paper-based assessment.

2. Assessment

Assessment is defined as a direct measure of what has been learned as a result of instruction on particular subjects [Gagne et. al., 1988]. Assessment for distance learning has not yet been thoroughly researched [Dirks, 1997]. Some of the principles of the common paper-based assessment made in the conventional classrooms do not apply in distance assessment, such as reporting feedback and security.

However, the Internet shall be used to create environments that facilitate an active and customized process of learning, supporting cooperation. In such a cooperative environment, assessment may not only involve measuring the students' ability to remember and repeat ideas, but should also make people think about problem situations and new solutions to them [Cox and Clark, 1996]. The strategy of Quest is to provide a simple multiple choice-like assessment tool that can be used not only to test the students but also to enhance the learning process.

In structuring a quiz it is important to work with a theoretical framework of learning. There are several learning objective taxonomies as can be seen in [Imrie, 1995], [Gagne, 1982]. Bloom's Taxonomy of Cognitive Levels [Bloom, 1956] divides students' abilities into six different levels, which are: knowledge, comprehension, application, analysis, synthesis and evaluation. Using Bloom's taxonomy, a teacher can make a deeper evaluation on the students' performance, instead of only checking their grades.

3. Description of Quest

The main goal of Quest is to serve as the Web-based assessment tool of the AulaNet™ learning environment. Its other goals include:

a. *Lowering quiz costs*: the process of creating, correcting and reporting student results in a paper-based system, of a large number of students, is very time consuming [Tinoco et. al., 1996]. This whole process requires time, money and staff that must be handled and administrated.

b. *Making extensive reporting*: Quest records all the information about the answers given by the students to make a comprehensive report of results for the teacher.

c. *Giving feedback to students*: instead of recording the results just for the teacher, Quest gives automatic feedback to the students, so they can have all the information about their performance on the fly, instead of asking the teacher.

d. *Enhancing the cognitive aspects of assessment*: while editing a question, the teacher tells which cognitive domain (from the six outlined by Bloom) he wants to assess. Thus, writing an evaluation must be planned, enriching its educational value.

There are many other assessment tools available, such as QUIZIT [Tinoco et. al., 1996], CADAL Quiz [Carbone and Schendzielorz, 1997] and QuizSite [University of Indiana, 1996]. However, they do not provide a graphical interface for question editing. These systems require that the teacher learn some tag language to create a quiz. Quest provides a graphical interface to make editing questions easier, without demanding any kind of computer knowledge being necessary. Other features of the tool include:

1. *Three question presentation styles*

Quest is a multiple choice-like assessment tool, but provides three question presentation styles for question editing: multiple choice (with up to five answer choices), true/false and fill in. Later, it may offer matching and listing.

2. *Editing Facilities*

The tool offers quiz editing facilities such as moving the position of the questions, removing questions and insert questions between existing ones. This is done automatically due to the graphical interface (non-textual) provided by Quest. Quest provides an easy way to reedit created quizzes, with a "save as" option, for the teacher not to loose the original one.

3. *Question qualifiers*

While editing a question, the teacher should give it some qualifiers, for example, the topic of the instructional material it will cover, the cognitive domain level it will test and its value. These qualifiers will be useful when displaying the statistics generated by the automatic correction of the quiz, giving richness to these statistics.

4. Automatic correction

The process of quiz correction is done automatically by the tool. The teacher only needs to specify the correct answers at the time of editing; thus, giving him more time to interact with the students. The correction mechanism stores all the data needed to make the statistical results provided to the teacher and the performance information handled just in time to the students.

5. Results displayed to students

Since Quest is a self-assessment tool, it is fair the students need not be dependent on the teacher to send them an e-mail to know about their performance. Carbone and Schendzielorz [1997] argue that this would increase cheating. However, self-evaluation serves to indicate to students, and not to the teacher, if they are doing well in the learning process, what denotes the importance of displaying the results to the students.

6. Storage of results for the student

Usually, the results of an assessment are stored for the teacher, so he can have a way of bringing back at any moment the information about any quiz on the course. Quest also stores the information to be displayed at any time to the students. This information includes: (a) grade; (b) total quiz points; (c) number of questions in the quiz; (d) number of questions the students answered correctly; (e) number of questions answered incorrectly; (f) time elapsed during the quiz resolution; (g) the topics enclosed in the questions of the quiz; (h) the topics of the questions the students answered incorrectly and (i) an option for the students to revise the quiz, comparing the right answers with those they gave.

This feature was included in the tool to provide a source of help material for further studying, as these results are formatted to show the problems the learners faced.

7. Detailed statistics for the teacher

The teacher can have plenty of information derived from the correction of a quiz. The main idea behind the statistics provided to the teacher is that he must have a way of seeing the students' learning development, to trace where they are facing difficulties and to compare the performances of the group as a whole, not, one by one, individually. These statistics include:

(a) List of grades: this list serves to see the grades of each student with an option to revise the answers given by all the students. This is the way it is done in the conventional classroom.

(b) Statistics based on topics: a result displayed as a list of topics gives the teacher a way to know the points of the instructional material the students are having problems with. The topics are atomic instances of the course, and interpreting these statistics can be useful to see if the material delivered by the course fits the needs and objectives of the students and those of the course itself.

(c) Statistics based on cognitive domain: these statistics show if the students are constructing their knowledge correctly. It exposes the cognitive abilities in which the students show more difficulty. After this verification, the teacher can reshape the contents of the course to solve these problems, really helping the students to: remember an idea; understand it; put it into practice; verify its component parts; use it to build another idea and evaluate its usage.

(d) Statistics per question: statistics showing the troubles the students had in solving each of the questions in the quiz. This can be used to see the average difficulty of the questions, and like a cross-reference of the two previous statistics it will show whether the students had problems in understanding a topic, or applying it or evaluating the usage of another one, for example.

(e) Standard scores: standard scores involve calculating average scores and information about how much these vary from high to low—the standard deviation. Average scores should be concluded with their standard deviation, and listing of the highest and lowest scores possible as well as the highest and the lowest scores actually received. It would end with a sentence like this: "There were 35 students who took the quiz. The possible scores ranged from 0 to 100, with the students actually scoring from 32 to 95 (average score: 72, standard deviation: 6.1)."

5. Architecture and Implementation Issues

The architecture of Quest is based on the Web, where its entire interface is developed, using CGI programs to provide all its functionality. The figure below shows the tool’s architecture.

The architecture has a presentation layer, which is the user interface. It is basically composed of HTML templates that help the teacher to create, edit and maintain all the quizzes. There are also some tips to help the teacher during the process. For example, if a teacher wants to create an analysis question, the tool offers him a list of verbs that are commonly used to write analysis questions. Another task of the presentation layer is to make input validation, i.e., verify if the teacher did not leave a field in blank, if he miswrote a date, etc. This feature makes Quest a distributed tool, with part of the processing resident in the client machine, due to JavaScript code.

The application layer is responsible for all the functionality provided by the tool. It is composed of CGI programs written in CGILua [Hester et al., 1997]. It uses Lua objects [Ierusalimschy et al., 1996] to perform the handling of questions, the generation and display of quizzes, automatic correction and the feedback statistics of the results for both students and teachers.

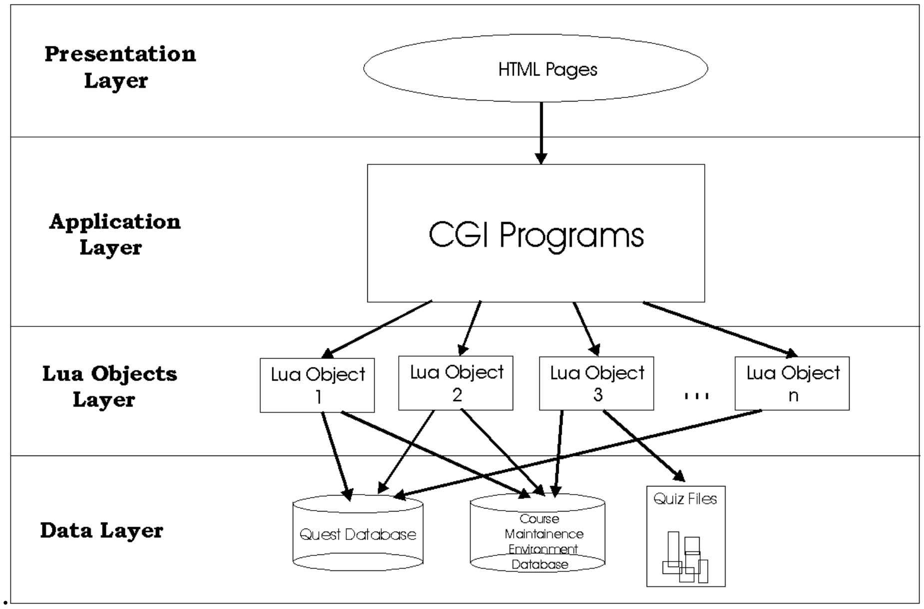

Figure 1: Quest Architecture

The Lua objects layer offers all the functionality needed to allow for the exchange of data between the CGI programs within the application layer and the data layer. It accesses the tool's database engine and also allows for the writing and maintenance of the HTML quiz files.

The data layer is composed of two databases and a file directory. The first database is a Microsoft Access database used to store the data related to questions and quizzes. The Lua objects of Quest only access this database. The second database refers to the data of the course maintenance environment, which describes the courses and the students who will use the tool. The file directory contains all the HTML files of the quizzes generated.

6. Conclusions

The Internet has great educational potential [Eales and Byrd, 1997] and Quest is a tool for generating quizzes and assessing materials on the Web. The process of creating and editing questions is made on a graphical Web interface, thus making the tool completely Web designed. It also aims to help teachers assess all the cognitive abilities of the students, not only their ability to memorize information. This tool delivers statistics both to the students and the teachers so that they can see if the material offered on the course meets all their purposes and needs.

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