A Framework for supporting Graphical Interactive Assessment

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Abstract: Online-Assessment is widely accepted both for self-assessment and also as the basis for examinations. However, its potential has not been fully made use of in current systems. Good instruments for innovative assessment are e.g. modern graphics based questions. Unfortunately, their production is still very time and cost intensive. The GIA project develops a framework, which provides a solution that enhances the process of "authoring, providing and evaluation" of graphics based questionnaires. The use of existing specifications will at the same time ensure the interchangeability of the course material.

Introduction:

This paper describes the work of a currently ongoing research project “Graphical Interactive Assessment” (GIA) at the research institute “i3mainz”. The project that is funded by the German BMBF (Federal Ministry of Education and Research) concentrates on automatic generation and evaluation of online-tests with a focus on graphical interactive questions. The application environment, where the results of the research will be applied to is the area of higher education within the teaching of the university of applied sciences in Mainz and the medical continuous education (Boehm 2003). In this paper, first the motivation for investigating in this field will be outlined; second the general concept of GIA will be sketched. Special attention within the paper is drawn on the new approach for the data representation based on existing standards.

Motivation:

Online assessment is widely accepted both for self-assessment and also as the basis for examinations. A good example demonstrating the success of online quizzes is the GIScience program (Veenendaal 2001). A well-accepted example of a tool for online tests is “Webassign” (Brunsmann 1999), it has been in use e.g. since 1998 by the “Fern-Uni Hagen”, the most popular Open University in Germany. Advantages arising from the use of such online-testing systems for authors are e.g. the reusability of test questions and better statistical feedback (Natal 1998). The critical problem of proper access control for the avoidance of misuse by the learner remains for non-classroom solutions but this will not be addressed within this project.

A lot of the current existing E-Learning and assessment systems focus on single or multiple-choice questions (MCQ) with several answers and radio-buttons to select the correct one. The forefathers of computer-based questions were designed like this, because MCQ are fast and easy to build – and can afterwards be corrected automatically. These types of questions seemed (and still seem) to be the ones that some teachers and professors in the educational sector prefer. To use these kinds of questionnaires saves time and cost, especially with large groups of learners. Moreover, faculties like medicine traditionally have long MCQ-tests where the students e.g. have to find the correct definitions or names of muscles. All this is very easy to verify, because the results are obvious. It should be noted that the pure application of MCQ is not undisputed – but the decision might be left to responsibility of the WBT author, or the responsible professor.

Reasons for new graphical based questionnaires (GBQ): Current pure text-based questionnaires are less intuitive for the user because they require mapping of the learned material and the subject of the question to predefined cases (a, b, c). This may subtract the concentration from the subject of the question. Moreover, it has been found out, that learners are more eager to circumvent the typical MCQ instead of doing the tests in a proper way (learn first and then carry out the test). Another reason for this might be the fact that most of the current questionnaires are boring. Often they are enhanced by images that relate to the topic, but these questions
are still simple MCQ with radio-buttons to select from. Alternatively to those very simple kinds of questionnaires, more innovative and well accepted solutions have been invented. Nowadays there are more types of questions that are asked already in computer-based tests. But mostly this has been done by the usage of Plug-Ins like Shockwave and Flash that allow questions with more graphical elements and interaction from the users. For example somebody is asked to drag an element to a specific position on an image. These questions show that there is a need for more interactivity and they are also a first step towards new concepts for GBQs.

Current solutions: A set of very powerful tools like e.g. the Macromedia Dreamweaver or the ToolBook Instructor allow to build complex questionnaires with innovative and content dependent graphical questions. The development of those questionnaires still requires profound skills in the usage of these tools. The effort can thus be calculated similar to full regular WBT learning courses. Additional development is needed for the automatic storage of the results in a learning record and for the presentation of the results to the professor and eventually to the learner. Thus innovative knowledge assessment by the usage of modern graphics based questions is still an expensive mean.

The new GIA Approach

The research performed within the GIA-project addresses this situation and tries to overcome the current limitations by developing a solution that supports the whole assessment circle by the use of adequate tools. The Editor and the Provision module can be seen in [Figure 1].

The GIA framework will provide the following functionality:

- A web-based Editor for developing graphical interactive questions. It allows an author fast and easy building of these types of questions through the use of an extendable catalog of question templates.
- A question-browser that enables the author to manage the questions within the database. It lists the existing questions sorted by topics and therefore allows an easy reuse of them.
- A new concept to store graphical elements from within these questions including the procedure for the automatic verification of them. This concept will be based on existing standards to enable exchange between different systems.
- A question provision module that displays the questionnaires to the learner by combining the template and the question-text with the overall layout.
- An evaluation module on the server for an automatic verification of the completed questionnaire.

The following example may illustrate the process of authoring: The following example may illustrate the process of authoring: A professor (author) has to build a questionnaire for an upcoming exam. He therefore starts his GIA Editor (See [Figure 3]) in order to build new questions. The following steps are: inserting the name of the course, the title, the text of the question and selecting the type of question that he wants to build. If the learner should e.g. be asked to draw a traverse between several points, the author may use the “free area” template. He then has to load an image with a map on and set points at the adequate positions. The Editor connects the points automatically and the author will determine the width of the buffer around these positions. Fine tuning might be necessary and can be performed afterwards. The information processed during the editing is then exported in an XML-file (see below).

The author then connects to the Internet and logs into the GIA-system. His login is verified from the server and his personal profile is loaded where he uploads the new question. Then he calls the GIA question-browser, where all existing questions are stored. The questions are ordered by types and topics and can therefore
easily be found, selected and inserted into a new questionnaire. The last steps are to assign scores to each question, to set the validation period and the group of learners that have to pass this test - and save it.

**Data Representation in the GIA Framework**

In order to develop a framework as described above, a well-defined data representation as the core of the whole development has to be worked out. The data representation is the base for all tools such as the editor, the provision module as well as the evaluation module. In order to ensure interoperability with other learning management systems, the application of an established standard or specification such as the Question & Test Interoperability (QTI) is mandatory.

Those existing standards/specifications provide a good basis for traditional MCQ. However, these typical MCQ differ from the GBQs that we are targeting in the GIA work. Two major differences can be identified. First, the graphical information for those questions is far more complex than the graphics information currently considered in the standards because it consists of a combination of raster, vector and time related data. Second, the evaluation of GBQs is more complicated than for MCQ, because it might not be possible to reduce the correct answer to a ‘case’. Therefore the verification cannot be a simple comparison. Instead, the evaluation will require evaluation scripts or routines which are specifically applied for each different question template and thus have to be mapped to the standardized format in addition to the questions. See [Figure 2].

**Application of Standards**

There are several existing specifications or standards concerning the E-Learning sector proposed by organizations like the IEEE, W3C, ADL, AICC, IMS. The GIA Framework selected the “Question and Test Interoperability”-specification (QTI) currently specified by the IMS (IMS 2002). Rather than other specifications QTI focuses on material for tests and therefore suits more the needs of the GIA project. Beside the technical advantages, QTI is well accepted and is currently used respectively can be imported/exported in products of companies like Questionmark, WebMCQ and Macromedia.

*Inclusion of Advanced graphics:* The QTI-specification currently does not include questions with vector-data and other more advanced graphics. But simple graphical questions using raster images are integrated. This approach has to be adapted to fit our needs, while at the same time stick to the given specifications. That will be one task of this project: to map the contents of the new questions to QTI. The proposed GIA solution for including advanced graphical elements is using the SVG format (W3C 2003). SVG has the advantage, that it is an XML-Format for 2D-Vector graphics that can be stored like the course material itself. The SVG-elements therefore will be mapped to QTI and together with the textual material inserted in the provided XML-structure. This file then contains all the information necessary for examination and evaluation. It can therefore be written into the question-database for later retrieval by the provision module.

*Learning Objects:* The questionnaires within GIA are divided into smaller parts in order to reuse them for other courses as suggested by Cholmsky (2000). They are managed by following the metadata standards like the Learning Object Metadata (IEEE 2002).
Inclusion of evaluation routines: The concluding approach of the inclusion of the evaluation routines into the selected specification has not yet been finally determined. Current tests consider the inclusion of the script source code within the question template file or alternatively as a separate module within the GIA system. For this subject further investigation will be necessary within the project period.

Expected Results

The project plan foresees the first running prototype by the end of 2003. This includes a running solution for the “inclusion of the advanced graphics” as well as the first approach for the inclusion of the evaluation routines. This first prototype will be applied in the targeted application environment (higher education and medical domain) within the first quarter 2004.

References:


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