Setting and Sharing Adaptive Assessment Assets

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Abstract. In this article, we present a proposal model to construct educative assessment assets using accepted standards and specifications like the IMS Question and Test Interoperability [1], in order to ensure that those objects could be shareable and compatible with several standardized Learning Management Systems. The model comprises four sections, following the steps from the definition of the assessment items to the use of them in a test inside of a Learning Management System.

Keywords: On-line Assessment, IMS QTI, assessment assets.

1 Introduction

In recent years, instructional and educational institutions have been incorporating information and communication technologies in learning and teaching processes in order to increase the quality, efficiency, and dissemination of education. As long as those projects cover the needs of individuals in a particularly way, the success and transcendence of such developments could be incremented by performing adaptability to each user so the learning experience can be enhanced.

To be sure that all of these efforts don't become groups of isolated isles, most of these projects look to be compliant to some accepted standards, so they can be interoperable, compatible and shareable between them. One accepted standard is the IMS (Instructional Management Systems) [2], a global learning consortium that develops and promotes the adoption of open technical specifications for interoperable learning technologies that become the standards for delivering learning products worldwide. Among the inherent importance of these works, we want to emphasise in the role of the assessment activity inside the e-learning process. We want to concentrate in this task, and see how it can help to improve the e-learning process to all the participants: students, teachers, and content designers.

The rest of this paper is structured as follows. In section two, we depict how we see the importance of the assessment activity in the e-learning process. In the section three, we describe our model for the creation of assessment assets, focusing in the first two phases: the authoring and the management of the items. In the section four we describe with more detail, the adaptation process of the assessment items. Finally, in the section five we give our conclusions.

2 Importance and characteristics of and Assessment Tool

Traditionally, assessment activity has been seen like task aside of the e-learning process and there is a danger in focusing research on assessment specifically [3], as this tends to isolate the assessment process from teaching and learning in general.

For us, the assessment activity after the student took the educative lesson, could be seen as an element that closes and complete a circular activity, being an integral part of the learning process as well. In addition, the assessment activity inside the e-learning process could be used to adapt the system by setting a new user knowledge level, evaluate, and setting new learning profiles, assign user grades and, in consequence, performing user content re-adaptation [4]. According to the Australian Flexible Learning Framework [5], assessment, especially when is included within a real learning task or exercises, could be an essential part of the learning experience, giving to the entire Web site the characteristic to adapt itself to the needs of the users.

Nowadays, it is necessary to produce educative Internet-based systems that permit the dissemination of the education, covering the needs of diverse learning group profiles. To obtain this, it is desirable that such systems perform automatic task to adapt itself to each user, disconnecting the content from its presentation by using a semantic approach rather than a syntactical one, defining a meaningful web.

In consequence, learning systems must be flexible and efficient, and one way to accomplish that is to be an open and standardized system. When we design a system using open standards, we ensure characteristics of interoperability, manageability, reusability, and durability [6].

3 Model overview

The model have four main sections (figure 1), some of them have three levels of conceptualizations with activity definitions form the abstract level (lower layers) to a more concrete level (upper layers). We structured the model starting with the definition of the basic core elements so we can evolve them to a more concrete definition, identifying their requirements and interactions between them at the same time.

3.1 Model Structure

Levels: from an abstract view to a concrete view:
In the first level (dark color), we identify the core elements (learning objects, management, test construction, and LMS interaction). In the second level (gray color), we describe the main sections, identifying four phases: authoring, repository management, visualization, and interaction with LMS. In the third level (white color), we categorize each activity into a subsystem (authoring, item management, publishing, and interaction with LMS).

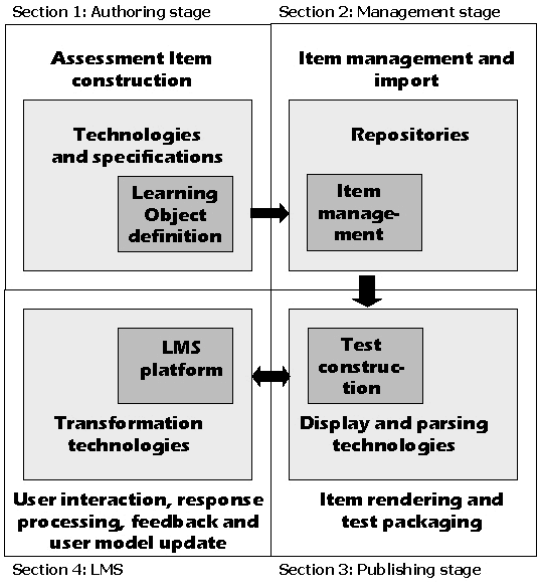

Figure 1. Model for the construction of exam items.

Sections: from the creation to the interaction with LMS:

Section one: Learning Objects Definition (ASI: Assessment, Section, and Items). We focused our research in technologies and specifications in the definition of this section; we use the authoring use-cases of the IMS QTI specification in this section [1]. In addition, we want to use the IMS AccessForAll [7] specification to define a resource profile for our assessment objects

Section two: Item Management. We define this section with the aim to give to the developer a tool to organize, manage, and import ASI from other authoring tools. We propose a native XML database management system to manage the items.

Section three: Test Construction: We consider in this section the activities made by the assessor to view the items by rendering them in a visualization system. We suggest using software like Flash [8], Shockwave [8], or XHTML [9]. In this section, the assessor selects the ASI to construct the test that will be delivered into LMS in a XML [10] format. In addition, we want to integrate data fields so the assessor could construct adaptability test by defining trees of related questions depending of the responses and the feedback presented to the user. We propose the development of a user interface for the students or candidate so they can access and respond to the exam, sending the results to the LMS to make an assessment record.

Section four: Test Delivery: In this phase, the candidate or student activates the test by accessing to it through an LMS, from which we get the learning style definition to make the adaptation.

3.2 Level one: an abstract definition (dark color).

3.2.1 ASI authoring subsystem (Learning Object Definition). A learning object is a reusable unit of instruction for learning activities, typically in an e-learning environment. The aim of the authoring system is to develop an interface for the development of learning objects to assess and grade the students learning that could aggregate in learning activities in the LMS. In order to be interoperable and interchangeable, the objects are defined in its smallest functional size: single questions that could be correctly identified and categorized so we can make an aggregation process in the publishing phase.

3.2.2 ASI DBMS subsystem (Learning Object Management). The item database is known as the ASI Repository in the IMS QTI specification [1]. This DBMS could be a relational database like the open system MySQL [11], but nowadays we could find XML databases that could store the items in its native format and make queries upon the stored data using the XQuery language [13]. In the traditional DBMS, we have to use a middleware to map the XML data, transforming the labels into tables and the attributes into columns, so we could store the XML file.

3.2.3 Publishing subsystem (test construction). In this step the assessor selects the ASI to visualize and evaluate apriori just before to publish them. Another activity is to select the ASI to construct the final exam that will be delivered to the LMS or the student itself. This process generates an output file in XML format.

3.2.4 LMS platform. The last step in our model is the delivery of the exam to the LMS so the user could interact with it and respond to the question.

3.3 Level Two: Definition of technologies to be used (gray color).

3.3.1 ASI authoring subsystem (Learning Management Definition). We want to use:

1. IMS QTI [1] to describe the assessment items. The QTI describe an information model and the associate representation to create and share assessment items. This element contains a group of interactions or questions and the supporting material like external file links and rules.
2. To define a first level of adaptability, we propose to aggregate to the item, metadata describing alternative resources to perform user adaptability. In this case we will use the IMS AccessForAll specification [7]
3. LOM, Learning Object Metadata (IEEE, 1990) [13]. This standard outlines the syntax and semantics of the Learning Objects metadata describing a small set of attributes that allow the objects to be managed, located, and evaluated.
4. Assessment item categorization. IMS QTI and LOM allow the author to categorize the items so they can be correctly managed and located, also in this process be can define a uniform resource identifier (URI).
5. File import. Those can be files in text format generated in word processor programs. Those files must follow some minimal rules in their structure, like special labels o words so they can be identified by a parser like question header, question text, question options and extra data to categorize and evaluate the item.

3.3.2 ASI DBMS subsystem (item bank description). We propose the creation of a user interface for the database administrator to access, management, and query of the ASI, also to import of new elements in XML-QTI format to this database. For the management of the ASI we suggest the implementation of a repository for items in XML format using a native XML DBMS using XQuery [12] to make queries, this DBMS could be the dbXML [14] system. The second process is the import of the ASI (created in other authoring systems) to the repository without any modification or adecuation of the data.

3.4 Level Three: Implementation (white color).

3.4.1 ASI authoring subsystem (ASI creation). This is a user interface for the author of the ASI, to select the kind of assessment item, type de item text and the responses with its values, the feedback and the links to the external supporting media. We suggest the use of an open DBMS (like MySQL) defining a table for each kind of question to save the items before make their transformation to the XML-QTI format.

3.4.2 ASI DBMS subsystem (required technologies). The DBMS for XML data manage the data in collections of items in a tree structure, storing the elements in their XML native format or even in binary format (DBMS records).

3.4.3 Publishing subsystem (test construction). The test construction is a process defined in the user cases of the IMS QTI [1] specification. The aim of this phase is to define a subsystem for item publishing so the teacher or assessor could visualize and evaluate each ASI, select them and construct the exam, packaging the questions in a XML format file that will be accessed by a Learning Management System. In this process could be possible to render the item to view their final presentation to the user. This phase could define a final user (student) interface so they could visualize and answer the test, sending the results to the LMS.

3.4.4 LMS platform. The LMS controls the activities of access control, response time, response processing invocation, and feedback supporting.

4. Adaptive Assessment Items

In this section, we want to focus in the adaptability processes that we propose for the assessment items. We divide this into two levels:

4.1 First level of adaptability: Defined in the authoring stage by using the IMS AccessForAll specifications, in this case the ACCMD [15] in which the author could select alternative resources (supplementary or alternative) to the primary ones, presented to the user by default. Those alternative media are presented adapted to the final user by matching the resource profile (defined in the authoring stage) to the profile defined by the user when he/she made their preferred selections that are recorded in the user profile (in this case we use the ACCLIP [16] specification).

4.2 Second level of adaptability: In the authoring stage, the assessment author could define a tree of additional nested questions, which are presented to the user based in his/her response to the actual item. In the test construction stage, the assessor could active this tree processing so the user is presented with feedback options and

showing additional questions based on current answers, taking into account the user profile defined by using the ACCLIP [16] the items are presented using the primary or equivalent resources.

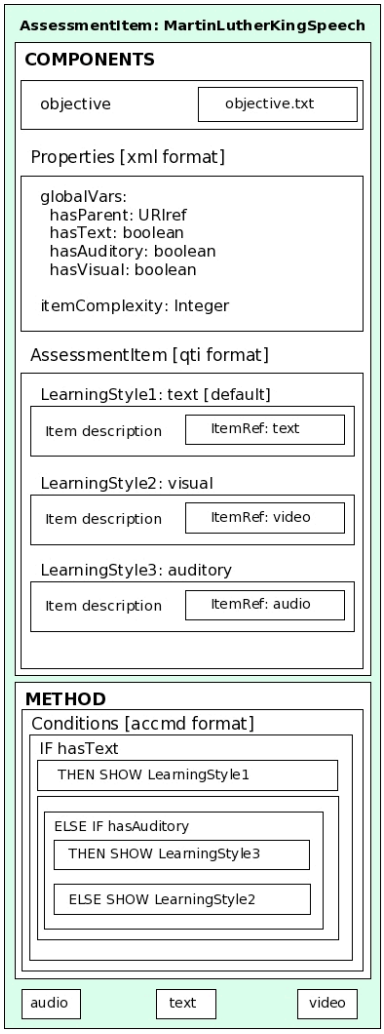

Figure 2: AssessmentItem package.

Figure 2 shows the package of a single assessment item, composed of:

1. Objective: is the description of the educational objective that is to be accomplished by the assessment item.
2. Properties: include the definition of the global variables to receive the values of the learning style of the student from the LMS. Also contain the categorization of the item as a root o leaf (defined by the value of the hasParent variable).

3. AssessmentItem element: Contain three files in QTI format for the description of the question for each learning style.
4. Method: Is a file with ACCMD format that contains the adaptation rules that will be performed according the values of the global variables.

5. Conclusions

Online assessment is an important step inside the e-learning process because gives convenient feedback to all participants in the process, helping to improve the learning and teaching experience.

According to the new developments in the area of e-learning we can see that most of them look to be compliant with accepted standards like the IMS QTI. This gives the convenience to those developments to be interoperable and adaptable to different platforms. In concordance, referring to the assessment activity we can think that it must be interoperable as well, because it is one element of the e-learning process and plays an important role inside this experience.

Adaptability is another key factor in assessment. Given the fact that assessment is an important element of the e-learning process and that this process looks to be interoperable, then we can think that the assessment tool could be used with different educative content administrators with different conceptualizations and ways to design and apply a test for their students. To face this situation it is necessary to develop an assessment tool that give several ways to design an test with different types of resources, different kind of assessments, group of students, kind of questions, managing schedules, etc.

Under this conceptualization, we want to create an Adaptive Assessment tool (AAT) that could take into account the specific characteristics of educational open systems. This application will allow the professor or instructional designer to integrate the test questions, with the supporting media and generate an output file in XML format, following the IMS specifications reviewed here. After that, the test is integrated with other learning activities inside a Learning Management System.

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