ADDING TAGS TO COURSES TO IMPROVE EVALUATION
A Multiplatform LCMS Approach that Allows Multidimensional Analysis

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Keywords: Tag, Bloom's Taxonomy, Educational Objectives, Metadata, Statistical Analysis, E-learning, SCORM, QTI, Learning Design, Authoring Tool, LMS, Assessment Analysis Model.

Abstract: The main idea of this paper consists in adding tags to the contents available in any given course materials structured according to any Learning Content Management System (LCMS). Tags, very popular in web 2.0 applications, give a free and flexible way of characterizing materials according to any criteria that a teacher can imagine. Therefore, one can use them for any specific analysis and clustering of both teaching methodology and students learning. Our approach claims to be platform independent in the sense that can be applied on top of any current LCMS. To achieve that property, we define a XML specification that includes specific, platform dependent, queries. This choice is much more efficient than building plug-ins or hardcoded solutions for any existing learning platform (and its underlying data-base). At the end of the paper, we show the powerfulness of this approach with a course example.

1 INTRODUCTION

A large number of specifications have been generated in order to standardize some aspects of the e-learning process, and also a large variety of proposals which standardize the educative contents. Successful examples are Sharable Content Object Reference Model (SCORM) (ADL, 2008) or some of IMS (IMS Content Package, IMS Simple Sequencing, etc) (IMS, 2001).

There are also other specifications, like Learning Design (LD) (IMS LD, 2003), that manage the eLearning sequencing process. LAMS (LAMS, 2002) is the main tool for creating this type of contents. However, its evaluation depends on the LCMS like Moodle (Moodle, 2008) or Sakai (Sakai Project, 2003), in which LAMS could be included. Concerning SCORM, its evaluation capabilities depend also on the LCMS that will manage it.

Besides, there are systems based on the Question and Test Interoperability (QTI) (C. Smythe, 2002) standard that focuses on the questions and their evaluations. By this last, it is easy to find analytical and statistical tools that allow us to increase the evaluation performance.

Generally, there is a lack of standardized reporting systems that could be used to achieve conclusions on the efficiency of the teaching and learning processes.

This paper proposes two new features: (1) a new specification (with the corresponding tool) to tag e-learning structures and (2) a methodology to efficiently connect our tool to any eLearning System. In this way, we pretend to improve the management of the learning evaluation, and at the same time, give flexibility to the evaluators to add any criteria, that can later produce a high variety of results using multidimensional analysis tools.

2 E-LEARNING STANDARDS ANALYSIS

There exist different e-Learning standards that emphasize different learning aspects. Following, we will briefly review them.

2.1 SCORM Introduction

The Sharable Content Object Reference Model (SCORM) is an aggregated specification for asynchronous distance learning, organized by the Advanced Distributed Learning Initiative (ADL).

Cespedes-Borras E., Rodriguez A., Carrabina J. and Serrano J. (2009).
ADDING TAGS TO COURSES TO IMPROVE EVALUATION - A Multiplatform LCMS Approach that Allows Multidimensional Analysis.
In *Proceedings of the First International Conference on Computer Supported Education*, pages 92-97
DOI: 10.5220/0001977900920097

One important issue in SCORM is the technique of packing course material sources, structure and metadata into one exchangeable object.

The content packaging format is defined by the IMS Content Packaging specification. Course package uses zip format. In the zip file, an imsmanifest.xml file exists, which is an eXtensible Markup Language (XML) file used to express organization and resources. Most standards follow this format. SCORM organization defines the course structure using a tree hierarchical model in which each item could be either a simply html content or a Sharable Content Object (SCO), an improved item that defines questions and tests.

SCORM 1.2 version is the most used. It is rare enough to find tools that implement version 1.3 completely (E. Cespedes-Borras, 2008). Evaluation tools are also simple and only produce a global mark for each course.

2.2 IMS Question & Test Interoperability (QTI)

This specification describes a data model for representation of question (item) and tests (assessment) data and their corresponding results reports. Therefore, the specification enables the exchange of obtained data (item, test and results) between authoring tools, item banks, test constructional tools, Learning Management Systems (LMS), and assessment delivery systems.

This specification is also divided in two parts: Assessment, Section and Item (ASI), that defines the structure of an exam with its questions; and Result Reporting (RR), that defines the qualifications of multiple students to any ASI element (from a single question to a full exam).

Despite this, metadata in QTI is very complex. There are eight question types, and for each question, metadata have more than 20 attributes. IMS QTI specification uses the industry standard XML as the way to relate data model information into physical representation.

QTI standard is widely accepted to design examinations. So, it is easy to find it in all LCMS as Moodle or Sakai. Analysis of exams can use the recently published tool (X. Gumara, 2008), QTI Result Reporting Stats Engine, one of the few OpenSource analysis programs available for this kind of applications.

2.3 IMS Learning Design (LD)

The IMS Learning Design specification supports the use of a wide range of pedagogies in on-line learning. Rather than attempting to capture the specifics of many pedagogical methodologies, it provides a generic and flexible language. This language is designed to enable the description of different pedagogical methodologies. A XML document, with its typical tree structure, is used as well. In this structure, LD defines activities and grouping types, what is more flexible than SCORM that only defines course items.

Learning Activity Management System (LAMS) is the main LD platform. It provides a highly intuitive visual authoring environment for creating sequences of learning activities. Even though, their tools are more focused on the course monitoring than on the analysis of the evaluation.

Table 1: Brief learning standard comparison based on their implementation state and tools.

	Specification Implemented	Tools	Evaluation Method
SCORM	1.2	Moodle	One global final result
QTI	Complete	Moodle, Sakai	QTI Result Report
LD	Level A	LAMS	LAMS monitoring and final result

After studying these specifications, we can conclude that: (1) most e-Learning models could be defined as a tree structure; and (2) there is a lack of analysis in most of tools (in the QTI case an improvement of the statistical data provided can be achieved); and (3) it does not exist a general statistical tool that could be used in cooperation with any standard or LCMS.

3 MULTIDIMENSIONAL DESCRIPTIVE SYSTEM

In order to outperform the evaluation, we propose to add new features, tags, to the descriptive data of any eLearning specification, that could be represented with an internal tree structure. Labeling can be understood as adding descriptions at any different depth levels of the tree.

Labels consist of one or several keywords, that will allows us to create a non-structured description to generate multiple classifications (see the example in section 6). This descriptive system is implemented as a set of descriptive tags. Tagging is an easy method to implement and its use is very popular (i.e. gmail classification of emails, delicious for bookmarks, etc), so that tagging is one of the key points of the success of a large variety of context-like web 2.0.

Our proposal of specification uses this concept of tag to specify each node from the abstract tree. Concerning the SCORM standard, the structure is a complete course and each description is assigned to each one of its items, and it does not matter if these are ASSETS or Sharable Content Objects (SCO).

In the case of Learning Design, tags will increase the data of each sequence item (activities or tool) that describe a course.

For the third case considered, QTI, each node represents an item or an assessment.

So, generally speaking, any system or educative standard that structures their contents in a tree shape, can be extended by the use of this methodology.

4 XML SPECIFICATION PROPOSAL

The eXtensible Markup Language (XML) is well-known language among the eLearning community and will be used to describe the proposed Advanced Statistical Evaluation of Education Contents (ASEEC) specification.

The specification is divided in two sections: (1) **dataSource section,** that defines the connection and access parameters to the data repository, and (2) **dataOrganization**, which defines the global shared structure (shown in Figure 1).

The aim of the first section is directly connect our analysis tool to data base through access parameters to get the complete tree structure whose tagging will be defined in the second section.

We consider that this option is better to generate tags on top of QTI Result Reporting, that has been studied as an interchange data format, due to the fact that this one is not platform independent.

Figure 2 shows an example on how ASEEC specification minimizes the complexity through this direct connection. Section **dataSource** is split in **dbConnection** and **dbDependency**. **Login**, **passphrase** and **url repository** are defined in the **dbConnection** subsection. Section **dbDependency** contains the SQL sentence that will produce, as a query result, the set of data to be further analyzed. Each format and type of every column are defined in this subsection.

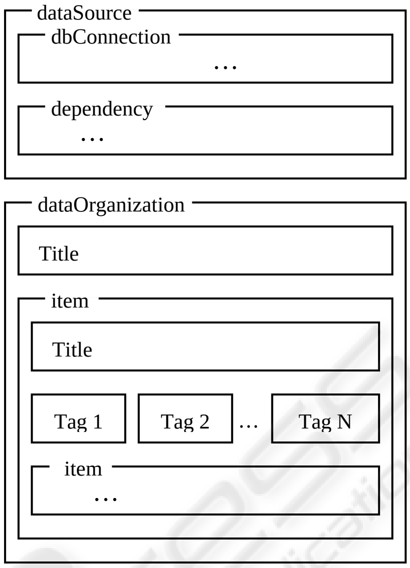

Figure 1: XML specification proposed.

```
<dataSource>
  <dbConnection>
      <property name="url"
         value="jdbc:hsqldb:hsql://localhost/roadrantz/roadrantz" />
      <property name="username" value="sa" />
      <property name="password" value="" />
  </dbConnection>
  <dbDependency>
      <column name="NAME_COURSE" type="STRING" label="COURSEIDENTIFICATOR" />
      <column name="GROUP" level="1" type="NUMERIC" label="GROUPIDENTIFICATOR" />
      <column name="GROUP" level="2" type="NUMERIC" label="GROUPIDENTIFICATOR" />
              ...
      <column name="VALUE" type="NUMERIC" label="VALUE"/>

      <sqlInjection>
         SELECT T1.NAME_COURSE AS NAME_COURSE,
                T2.ID_GROUP AS GROUP,
                T2.NAME_STUDENT AS NAME_COURSE,
                T1.ID_NODE AS ID_NODE,
                T1.VALUE AS VALUE,
                T1.TIME AS TIME
         FROM TABLE1 AS T1, TABLE2 AS T2
         WHERE T1.ID = T2.ID
           AND T1.ID_COURSE = 1;
      </sqlInjection>
  </dbDependency>
</dataSource>
```

Figure 2: dataSource structure.

Second section, **dataOrganization**, contains the abstract tree structure of the course. Each item of the structure is formed by a title, a set of tags and the corresponding recursive items.

5 PLATFORM INDEPENDENT APPROACH

By implementing the specification presented in this paper, it is possible to define a minimum connection model between LCMS platform and an external analysis tool (described in figure 3).

This type of connection will allow us to use the specification of the course structure (as presented in previous section) to extract the essential contents of the course.

A critical technical point of our proposal is to set-up, for each LCMS, the right parameters of the query sentence to the corresponding data base. The expected output of the query will be a table containing one row per each user for a given course and item. The format and value of each column will be given by the specified parameters of the query.

Once the course structure is obtained, we can add tags. The purpose of this tags is to add any attribute that a teacher can consider useful to get a an evaluation (for both students and teaching process).

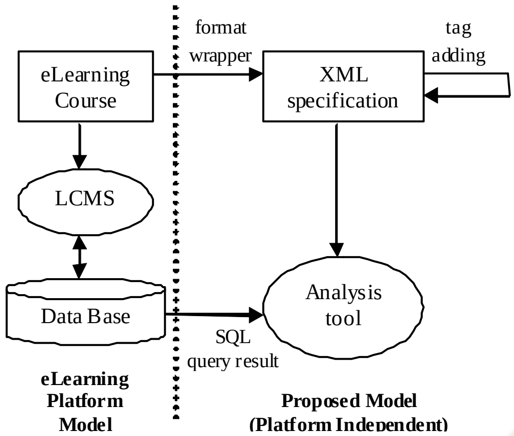

Figure 3: Multiplatform design.

As a result, we will dispose of a tool able to connect to any LCMS system, without the need to build neither a plug-in nor modifying the code of the LCMS. Though it was not our primary intention, this would let to a unified analysis model able to be used with different LCMS (nowadays it happens some times that a professor has to use two different LCMS even in the same institution).

5.1 Implementation Case Example

Figure 4 shows a potentially real implementation application case of ASEEC specification. In a given university campus professor can use either a Moodle server, a proprietary SCORM LMS (i.e. for courses rich in multimedia content), a proprietary LMS (i. e. from the beginning of virtual university courses) or any combination of them.

Finally, the proprietary LMS, that still contains a large amount of course materials of that university, has a proprietary format. Again, the hardest step is to define the SQL query that would be injected.

Previous two cases would potentially be solved quickly if the access policy to the corresponding LMS managers is open enough.

Once the three ASEEC XML files are created, our (or any) external analysis tool can connect to each LMS platform transparently.

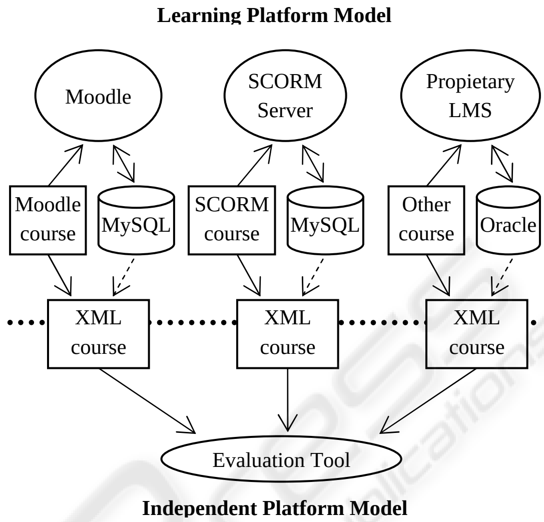

Figure 4: Real implementation case.

6 IMPROVEMENT OF ANALYSIS AND EVALUATION

Adding tags to the course structure is oriented to allow any multidimensional evaluation wanted by the teacher, thanks to due the possibility of including different tag sets to describe the contents, not only questions and answers.

A set or group of tags can cluster for instance the contents of the course, the taxonomy of educational objectives (Bloom, B.S, 1956), the type of activities made by the students, or any other knowledge the teacher would like to include in.

These clusters will allow to group students results according to the teacher needs at any moment with the evaluation tool. This is helpful to improve the evaluation of both course and individual students.

The course evaluation improvement is possible by detecting a general lack in some defined educational objectives. On the other hand, the teacher has the possibility to analyse the level of knowledge acquisition of any single student (or group of students) in any particular type of content or activity.

6.1 Evaluation Use Case using Tags

In this section, we present an specific case devoted to illustrate the potential use and improvement given by our tool.

The Signals and Systems teacher of the computer science degree wants to apply a taxonomy of educational objectives in his subject and he wants to know if all of them have been achieved by the majority of students.

He also wants to detect possible failures in the development of the different type of activities.

In order to get a better evaluation, the teacher imports the course from the Moodle platform where it is done and adds suitable tags (non exclusive) for each course element (nodes in the course tree XML specification).

He groups the course tags in three clusters (as shown in Figure 5): content description, Bloom's Taxonomy and type of activity.

Module 1: Description of Signals and Systems.

1. Enumerate basics signals and relationships between them: *<signal description>*, *<knowledge>*,*<lecture>*, *<homework>*
2. Say if a signal is periodic and what the period is. *<signal description>*, *<application>*,*<seminar>*, *<homework>*
3. Say the amplitude, frequency and phase of a sinusoidal signal. *<signal description>*, *<knowledge>*,*<lecture>*, *<homework>*
4. ...

Module 2: Analysis of Systems.

...

Module 3: Analysis of Signals

...

Figure 5: Tag adding to a defined course.

After the course is given, a set of results are stored in the MySQL database by the Moodle platform.

With the new evaluation tool, he will obtain the database results for all students of the course and the course schema enhanced with the tags he added.

Then, he will generate some figures (i.e. graphs) about the results combining the multiple dimensions of tags until he find something strange.

In the example given by figure 6, one can find that qualifications for the analysis (educational objective) are too low (4^{th} set of bars). This is even more important due to the fact that most of the subject contents of that course (Signals and Systems) are related to analysis.

In a deeper analysis, the teacher will try to find if there is any specific module with low qualifications than others or if this behavior is general for all modules labeled as analysis.

He will generate a graph that shows the qualification rate for all modules and elements with that tag and discover that the analysis mark in seminars has lower qualifications than in the other activities (as shown in figure 7). So, at the end, he will know that he must improve the way he is giving the seminars.

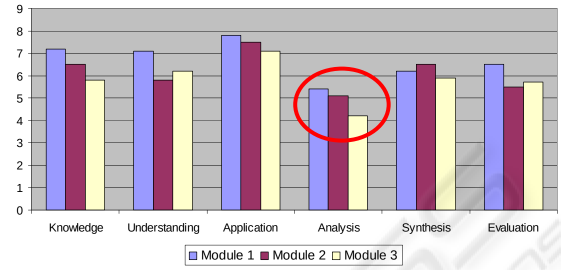

Figure 6: Clustering the course results in Bloom's Taxonomy educational objectives.

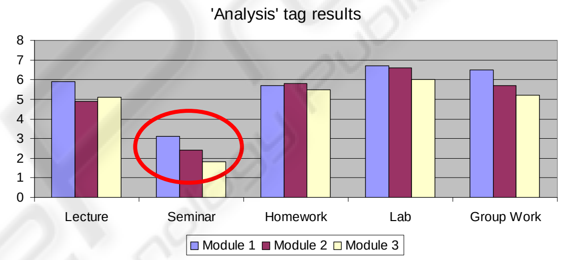

Figure 7: Clustering the analysis tag course results by the type of activity done.

7 CONCLUSIONS

In this paper, we have proposed a new specification to improve the management of the learning assessment giving flexibility to the evaluators to enhance the descriptions of any given eLearning course contents with the tags (metadata) they decide to add. The proposed model can be adapted to most of the existing LCMS, as well as any other learning models that structures its contents hierarchically.

This flexible addition of tag in any course content structure allows a better assessment by means of clustering the results according to any set (multidimensional) of labels any teacher can imagine.

We pretend in a close future to extend the proposed XML specification to allow the acquisition of results from other sources, not only from databases. We are specially interested in the support of the QTI Result Reporting format to make NOM QTI compliance.

REFERENCES

Advanced Distributed Learning (ADL) – SCORM (2008). Retrieved December 1, 2008 from http://www.adlnet.gov/scorm/

IMS Global Learning Consortium (2001). Retrieved December 1, 2008 from http://www.imsglobal.org

IMS Learning Design (2003). Retrieved December 1, 2008 from http://www.imsglobal.org/learningdesign/

Learning Activity Management System – LAMS (2002). Retrieved December 1, 2008 from http://www.lamsinternational.com

Moodle (2008). Retrieved December 1, 2008 from http://www.moodle.org

Sakai Project (2003). Retrieved December 2, 2008 from http://www.sakaiproject.org

C. Smythe, E. Shepherd, L. Brewer and S. Lay (2002, February), *IMS Question & Test Interoperability: An Overview*, Final Specification, Version 1.2, IMS

E. Cespedes-Borras, L. Vicent, M. Segarra (2008, September), *WIP- New Data Structure In SCORM 2004 Sequencing & Navigation*, FIE.

X. Gumara, L. Vicent, M. Segarra (2008, July), *QTI Result Reporting Stats Engine for Question-Based Online Tests*, ICALT.

Bloom, B.S. (Ed.), Engelhart, M.D., Furst, E.J., Hill,

W.H., & Krathwohl, D.R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain.* New York: David McKay.