A New Approach for SCORM Compatible Database Design

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Abstract: *The paper discuss how to modify the Database of the e-Learning platform eLSe in order to achieve conformity with SCORM specifications. This conformity will make the learning content reusable and will enable exchange of courses between eLSe and existing learning management systems (LMS) and content management systems (CMS).*

Key words: *e-Learning, e-Learning Shell, SCORM, Database, CMS, LMS, Meta-data, Sequencing*

INTRODUCTION

According to the recommendations of the Directorate-General for Education and Culture of the European Commission, one of the basic criteria for evaluating the level of use of information and communication technologies in the university training process will be the number of published WEB based courses [2]. An effective solution to comply with the requirement that every lecturer should make his or her teaching materials accessible via Internet is the use of electronic learning platforms, which are integrated environments for delivery, implementation, modification and management of WEB based teaching materials and communication between lecturers and students.

In response to this initiative a team from the University of Rousse developed an e-Learning software platform named eLSe [1] that enables lecturers to publish their own WEB-based course without having any skills and knowledge in HTML, JavaScript and other WEB-programming languages or tools. So far the platform is installed in 11 Bulgarian universities and 2 foreign institutions. The user friendly interface and simple mechanisms for uploading learning materials allows building a variety of courses in various knowledge domains. Currently there are 80 courses, uploaded on the university server with 3800 registered users.

As a result of the emergent growth of e-Learning systems and evolution of the information technologies, the number of WEB-based courses continuously increases. A necessity for standardization of content packaging arises. The purpose of content packaging is to be ensured the interoperability between the learning management systems and re-usability of the learning content i.e. to be provided a way to exchange digital learning resources between different systems or tools.

The basic problem that is to be solved at the present moment is modifying the e-Learning platform eLSe in order to achieve conformity with SCORM specifications. This conformity will make the learning content reusable and will enable exchange of courses between eLSe and existing learning management systems (LMS) and content management systems (CMS).

LAYOUT

There are several specifications regarding learning technologies. The most common and important ones are the Instructional Management System Global Learning Consortium (IMS), the Customized Learning Experience Online (CLEO) Lab project, the Advanced Distributed Learning's Sharable Content Object Reference Model (ADL SCORM), and the Aviation Industry CBT Committee (AICC) [3]. On the accredited standard front, the IEEE Learning Technology Standards Committee (IEEE LTSC) is working with the International Standards Organization (ISO) to transform the leading specifications into accredited international standards.

SCORM (Sharable Content Object Reference Model) [5] is one of the most significant and widely used specifications for learning content packaging. The SCORM Content Model describes the SCORM components used to build a learning experience from learning resources. The Content Model also defines how these lower level sharable, learning resources are aggregated into higher-level units of instruction. The SCORM Content Model is made up of Assets, Sharable Content Objects (SCOs) and Content Organization. The most basic form of a learning resource is an Asset. Assets are an electronic representation of media, such as text, images, sound, assessment objects or any other piece of data that can be rendered by a Web client and presented to a learner. A SCO is a collection of one or more Assets that represent a single launchable learning resource.

A SCORM Content Package contains two major components:

- A special XML document describing the content structure and associated resources of the package called the manifest file (imsmanifest.xml). It is required to be present at the root of the content package.
- The physical files making up the content package.

The conceptual diagram, illustrating the components of packed learning content is presented on Figure 1.

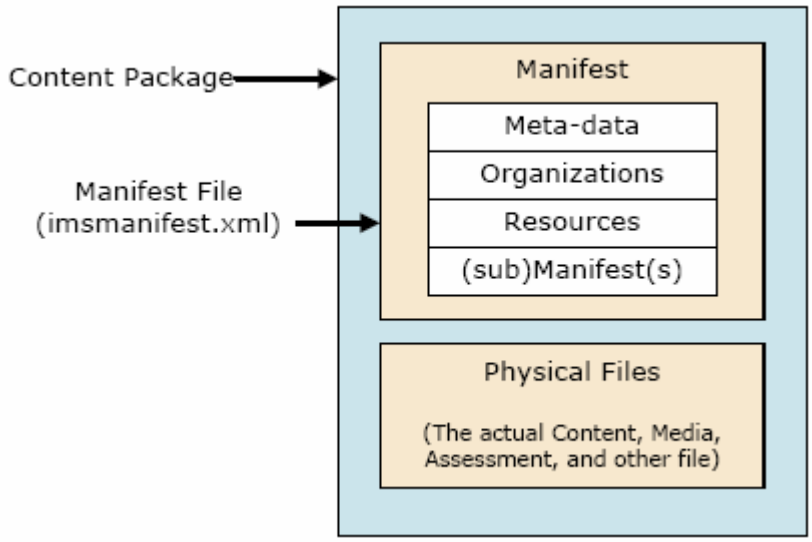

Figure 1

Components of packed learning content

A content package, as shown on Figure 1, includes the following components:

- Meta-data – data describing the content package as a whole;
- Organizations – contains the content structure or organization of the learning resources making up a stand-alone unit or units of instruction;
- Resources – defines the learning resources bundled in the content package;
- (sub)Manifest(s) – describes any logically nested units of instruction (which can be treated as stand-alone units).

Currently each existing course in eLSe is described with a set of tables, containing information about its content. To a certain degree this structure is not very well optimized since the number of the tables is significant, but the information they contain is not so much.

Following the recommendations of the Directorate-General for Education and Culture of the European Commission [2], each course in eLSe has preliminary defined structure including: Annotation, Literature, Lectures, Tests, etc. At present this structure cannot be modified and implementation of hierarchy in its separate items is impossible. According to SCORM specifications, a XML package of a course could be represented as a hierarchical structure (Figure 2), which can be considered as a content organization.

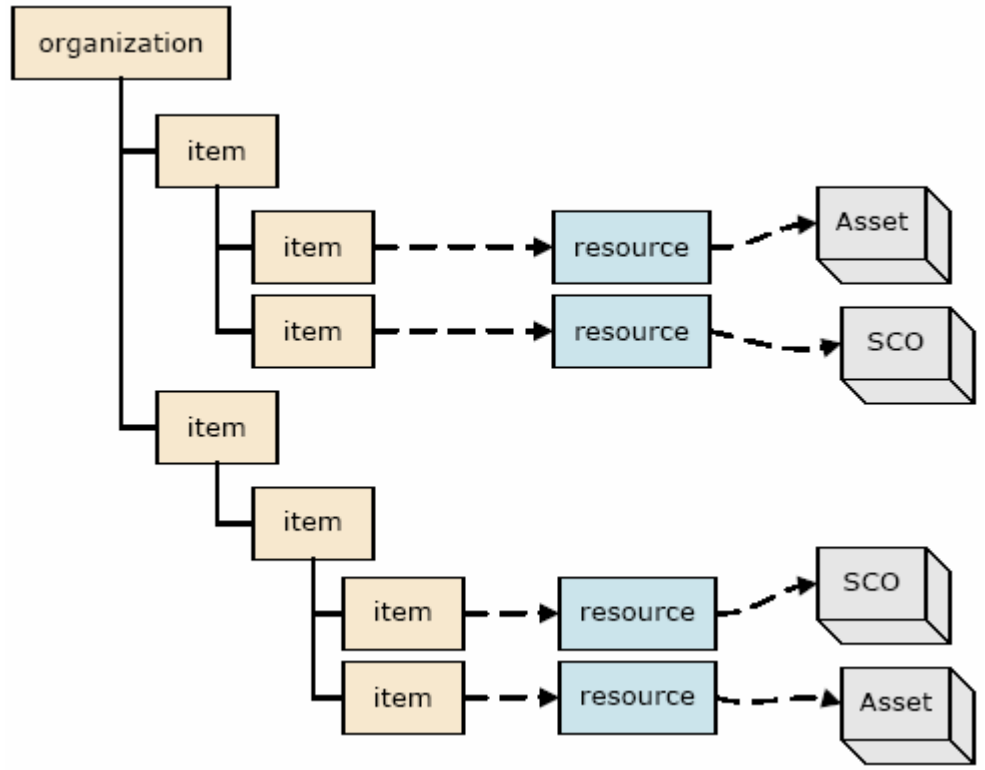

Figure 2

The hierarchical structure of SCORM XML package

Another approach to organizing learning resources is to define a hierarchy of activities that rely on the resources to provide a specific learning experience. In this case the top-level of the hierarchy is the main activity, which can consist of sub-activities, which can themselves consist of sub-activities. Depending on the design methodology, this hierarchical grouping might be used to represent concepts like Course, Chapter, Topic or similar terms that represent how the content is organized for delivery to a learner.

After analyzing the problem a methodology is developed for reorganizing the e-Learning platform and existing learning content. The first step is implementation of new data base logical model. This model should be largely close to SCORM Content Aggregation Model [4]. The attempt to implementation of this step is subject to discussion in this paper.

Requirements to database logical model:

- to be conformable to SCORM CAM.
- to enable easy transformation of existing information to XML description.
- to avoid creation of table set for each course. The course content should be stored in a centralized repository. This will help to be achieved reusability of the learning content and will reduce the number of tables in the database.

Here should be discussed the mechanisms for storage of XML description of the learning objects (Meta-Data) and Sequencing description.

When a learning resource is created with the intent to make it reusable, it is a best practice to describe the learning resource with meta-data. Meta-data allow the learning resource to be found when it is stored in a content package or in a repository. Such meta-data is considered context-independent. When the use of a learning resource is defined as part of a learning strategy, additional meta-data may be used to describe the activity that uses the resource. Meta-data that is specific to a particular learning strategy is called context-specific meta-data and is incorporated in the content organization.

As recommended in SCORM specification, Meta-Data is stored using XML. For eLSe developers are provided two possibilities:

- storage of XML description of Meta-Data in a field of a database table.
- storage of XML description of Meta-Data as an external XML file. In this case in the table will be stored a link to the file.

This involves formulating additional requirements to eLSe:

- It is necessary to be implemented a Meta-Data generating system. The system should read the information, entered via WEB forms during content packaging process.
- When a learning resource is uploaded the authorized user should enter the necessary information in a WEB form. In order to be facilitated the user, a part of the information that already exists can be extracted from the user profile, created during user's registration in eLSe.
- A Meta-Data analysing system (XML parser) is needed to represent the stored information in an appropriate way.

Within SCORM, sequencing information is defined on the Activities represented in the Content Organization and is external to the learning resources associated with those Activities. It is the responsibility of the LMS to launch learning resources associated with the activities in response to applying the defined sequencing behaviours. This is conceptually important because learning resource reuse is limited if a learning resource has embedded sequencing information that is context-specific to the course. For example, if a learning resource contained a "hardwired" branching to another learning resource under specific conditions, it could not be used in a different course in which the second learning resource might not be applicable or available. The reusability of a learning resource depends on it being independent and self-contained.

SCORM recognizes, however, that some learning resources may contain internal logic to accomplish a particular learning task. Such a learning resource might branch within itself depending on user interactions. These branches are all self-contained, relevant to a stand-alone learning resource and are not usually visible to the LMS. Importantly, internal branching must not reference external learning resources that may or may not be present in other content organizations. This is an important area that content developers should pay attention to when determining what learning resources should be used and how they are to be aggregated.

Sequencing, as well as Meta-data is described via XML. That is why there are two possibilities for storage sequencing information:

- storage of XML description of sequencing in a field of a database table.

- storage of XML description of sequencing as an external XML file. In this case in the table will be stored a link to the file.

The specific characteristics of users, who upload and modify the learning content in eLSe enforce selecting the first method for XML description storage. Users have no knowledge about XML, therefore XML descriptions of sequencing should be generated automatically when a learning resource is uploaded. Unlike Meta-data in this case is impossible to be used existing information fragments, since the sequencing information is unique for each learning object.

In addition a Sequencing description analysis system is needed to represent the stored information in an appropriate way.

Taking into account the discussed above and following the concept of SCORM Content Aggregation Model a logic model of a database, which will serve eLSe in its specific context of use is developed. Particular illustration of the tables' structure is represented in Figure 3.

The information will be stored automatically in the database by the course management system when a new course module is created, or a new learning object is uploaded. This process will not require entering XML description by the authorised user who creates a new course or uploads learning materials.

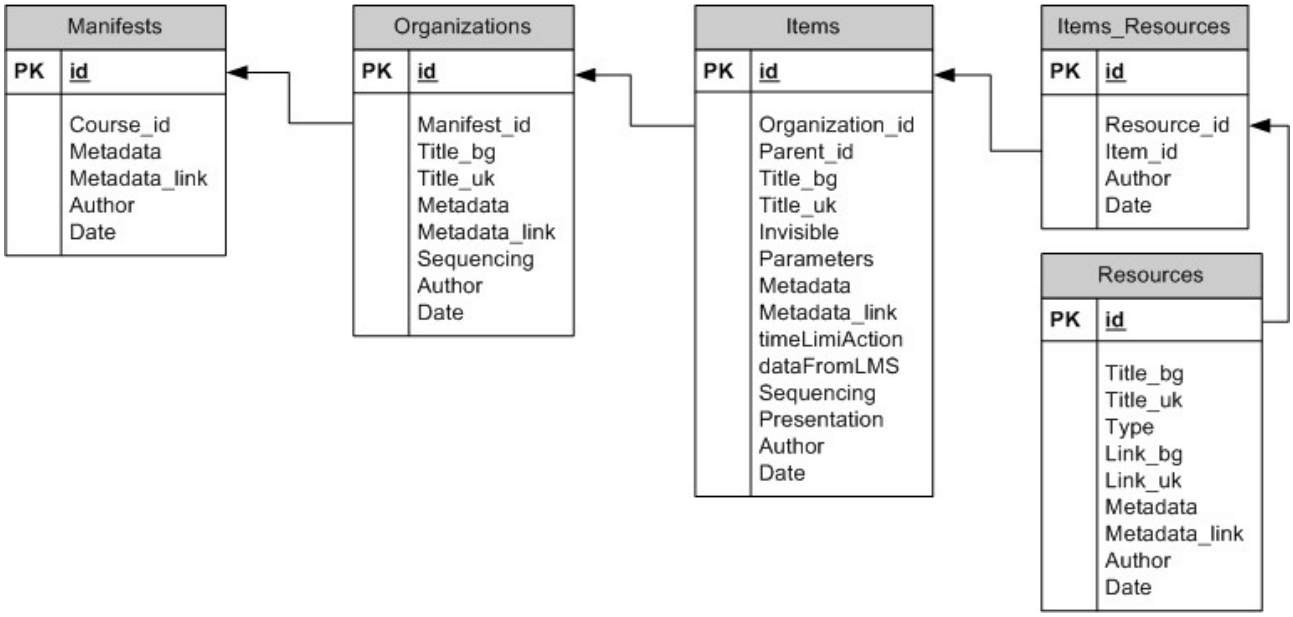

Figure 3
Database tables' structure

The main goal is to be reduced the amount of information that will be entered by the user during the mentioned above activities. It could be achieved through creation of a detailed user profile when a user registers to eLSe. When the user uploads materials this profile will be retrieved from the database and will be packed into XML by the Meta-data generating system. The rest of the required information concerning the concrete material will be entered by the user via appropriate WEB forms. This information will be read by the Meta-Data generator, which will produce the corresponding XML description and will store the whole XML package in the database.

In an analogous way is organised the process of entering the Sequencing information.

The whole course package will be accomplished by special XML generator, which will read the hierarchical structure (Figure 2), stored in the database and will generate XML description according the recommendations of SCORM CAM. The description will be exported in a file imsmanifest.xml that will be placed in the root directory of the course as the XML description of Meta-data and Sequencing will be included automatically in the structure.

The extraction of courses will be performed by three basic XML parsers, which will execute the following tasks:

- Analysis of course structure;
- Analysis of Meta-data;
- Analysis of Sequencing.

The extracted information will be delivered to the system for course visualisation and navigation.

CONCLUSIONS AND FUTURE WORK

An analysis of the recent specifications for interoperability and re-usability of learning content - SCORM Content Packaging, SCORM Meta-data and SCORM Sequencing and Presentation is performed.

On the basis of the analysis results is proposed a data base model for the new, SCORM compatible version of eLSe. The mentioned above specifications are taken into account during the process of data base model implementation.

In the future the following modules will be developed and included in the system:

- XML analysing tools for Content package, Meta-data, Sequencing;
- XML generator for Content package, Meta-data, Sequencing;
- New navigation system for WEB based courses;
- New system for course development;
- Systems for synthesis interpretation and execution of IEEE ECMA Script, concerning SCOs' behaviour.

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