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Modeling Projects in E-Learning Course: A Case of an Information Technology Project

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Abstract: Problem statement: Achieving projects is primordial in the process of teaching in several disciplines, particularly software engineering courses. However, proposing this learning activity in a context of e-learning is not automatically guaranteed by the current platforms, even unsupported by the existing standards for creating educational content. **Approach:** Through this study, starting from the model developed in the "XESOP-Jaxe" project to represent the contents of an e-learning course, we tried to propose an improvement in order to formalize a project for learners as a learning object. **Results:** We grafted our model, formalized in XML Schema, to the "XESOP-Jaxe" schema of the course. Thus, to the elements that could constitute a course, comes a new element called "projet" (project). **Conclusion:** This model was built and tested within the "XESOP-Jaxe" platform whose goal is to provide an effective solution for creating educational content in compliance with existing standards.

Key words: E-learning platform, educational content, XML schema, IT project, web, metadata

INTRODUCTION

The emergence of e-learning has led to a proliferation of platforms whose purpose is to group a set of features to support the needs of the training. These features have been the subject of several studies and have even made different lines of research. One of the most studied areas is the management of educational content, which focuses on organizing and facilitating collaborative creation of content. Content for which a set of meta-data standard have emerged (LOM, SCORM and IMS) (Prpitsch and Veith, 2006).

In this study we are interested in studying the XESOP project (Madjarov *et al*., 2004; 2005; Madjarov and Boucelma, 2006). This project involves the creation of a platform called "XESOP-Jaxe" which ensures a consistent semantic structure according to SCORM and IMS standards, the creation of learning content and building a course for the learner. The essential elements of the project are, on the first hand, a semantic media for the creation, presentation and storage of learning objects based on XML technologies and on the other hand, means for the management of the student course and performing remotes educational exercises based on Web Services (Madjarov and Boucelma, 2006).

We will focus on the study of the scheme adopted in this project for the modeling of a course. This study focuses on the modeling of a course that may be a course with chapters or tutorials or practical study but does not consider the case of project within a course. But, in e-learning, we are often confronted with the problem of project management. Indeed, if a teacher wants to offer, as an activity related to his course, the achievement of a project, e-learning platforms do not provide effective tools to facilitate management and monitoring of such activity, like other activities such as exercises, questionnaires or simulations.

We propose in this study to meet this need and solve this problem by adding the concept of project to the schema developed in XESOP by studying the particular case of a proposed IT project in a course on software engineering.

Project in e-learning courses: Traditionally, the project is an activity that is a part of the learning process and validation of knowledge and skills especially those with a technological aspect. This activity implements skills of analysis, specification, design or software development for example. So the project as a medium of learning is almost always adopted by teachers in their pedagogical approach.

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However, this activity is not more or less supported by the e-learning platforms. There are many reasons for this.

First note the complexity of this activity that involves many stakeholders: Teachers, supervisors, learners, not forgetting a teaching tool. These actors interact with each other and in multiple ways. They continually adapt, cooperate, communicate and negotiate. Proposed projects in courses, if we consider their initialization phase by the teacher, realization by student groups, monitoring by supervisors and assessment by evaluators (a jury), involve many teaching methods of initialization, management, monitoring and evaluation. In addition to being highly interactive and multi-partner, they involve large amounts of data and relationships between these data and they are scalable.

Thus, as a starting point to solve this problem, we consider that a project is related to a learning object. Unfortunately, such an object is outside of what the standards have identified through specific models. Though many of the items handled during the implementation of a project (simulation, demonstration, evaluation, experience, lessons, animation, tutorial, glossary, guide, reference materials, methodology and tools) are considered in the standard (Prpitsch and Veith, 2006).

Project in software engineering course on an e-learning platform: We propose in this research to study the formalization of a computer course and we take as an example a course in software engineering. This formalization is in the form of learning objects. In software engineering, where it is about learning how to analyze, model and design a software application, the contribution of the project in the learning process is useful because it allows the learner to implement all the concepts seen in the course.

We consider that such a project has a start date and end date and we consider that a project is modeled by the WBS method (Brotherton *et al*., 2008) which is a hierarchical and task-oriented decomposition of the study that the project team must perform to achieve the project goals and produce desired deliverables. The development process of software project can be decomposed into many activities throughout the project: Design, modeling, implementation of a computer application, testing, validation and deployment.

To give an overview of the educational context we propose a presentation of standards mentioned earlier.

LOM: The Learning Object Metadata finds its place as a metadata model for describing resources in educational purpose. It defines a learning object as "any entity digital or not, used in a process of education, training or learning. In fact, it is typically used to describe digital resources.

The Learning Object Metadata (LOM) is a standard published in 2002 by the Learning Technology Standards Committee (LTSC) of Institute of Electrical and Electronics Engineers (IEEE). The standard consists of four parts:

- IEEE 1484.12.1-Conceptual model of metadata
- IEEE 1484.12.2-Implementation of ISO/IEC 11404 in LOM model
- IEEE 1484.12.3-Definition and implementation of XML schema for the LOM
- IEEE 1484.12.4-Defining the framework for implementing RDF (Resource Description Framework) for the LOM

The LOM is structured into nine categories each performing a different function:

General: The function of this class is the description and identification of the resource. The contained information can refer to other categories and establish general interactions with information systems.

Life cycle: The life cycle can get information on the history of the resource and its contributors. Information collected here will be used to manage the resource.

Meta-metadata: Meta-metadata can keep track (detailed enough) metadata schema used to describe a resource. This information will be useful to consider the interoperability of different systems and for data exchange.

Technical: This category presents specifications that allow the execution of the resource on a computer system. Technical constraints of use can be expressed here. This category is used to describe, assess and manage resources.

Educational: Teaching is the heart of the LOM. That makes it unique compared with other models. This class performs an educational description of the resource. One can find in this class: The context (school, higher education, training, other), the intended end user role (teacher, author, learner, manager), the difficulty (very easy, easy, medium, difficult, very difficult), the typical age range of learners which the resource is intended to, the typical learning time, the language, the level (very low, low, medium, high, very high) and type (active,

expositive) of interactivity. And the key element in this category: The Learning Resource Type which may be part of the list: Exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self assessment or lecture.

Rights: Here are the legal requirements for use of the resource: Information about costs, licensing, copyright and other restrictions.

Relation: This category will link two physical resources among themselves, giving a value to this relationship, a sense (is part of, is version of, is format of or is referenced by).

Annotation: Can make comments about the resource, while keeping a description of the person who commented and the date of this commentary. This category provides additional information relevant to assessment of the resource.

Classification: This is the category that allows the assignment of classifications and controlled vocabularies to a resource. Classifications can be attributed according discipline, educational prerequisites, educational objectives, accessibility restrictions, skills or competency.

The LOM model is very rich. It is possible to identify several types of metadata: Descriptive, administrative, rights management, preservation and interoperability.

Furthermore, the implementation of such models requires a large support from policymakers and integration into the information system in which management of educational resources is included. It would be utopian to think that one person could fill in all fields of LOM data. It is essential to have databases of educational resources in a consistent good quality.

Sharable Content Object Reference Model (SCORM): It is a result of a process of standardization among actors in American government, academics and industrialists (Furht, 2008). The Advanced Distributed Learning (ADL), project of US. Department of Defense (DoD) brought together a federation of heterogeneous actors including Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE), Aviation Industry CBT Committee (AICC), Institute of Electrical and Electronics Engineers (IEEE) and Instructional Management System (IMS). This initiative was launched by the AICC at first, but rather for the off-line - including the airline industry: It was to bring together the study done in universities and private companies.

The standard most commonly used today is version 1.2 of SCORM (Prpitsch and Veith, 2006) which deals with the aggregation model and execution environments. The new version of SCORM released in 2004 clarifies some points of version 1.2, in order to specify sequencing and navigation.

SCORM addresses several needs:

- Interoperability between educational contents and software applications. An interoperable course can run on different computer applications. Specifically, it is about ability to use the same course in different platforms or conversely integrate to its own platform courses from various sources
- Sustainability and risk management. The platforms are very volatile tools: The costs of operating a platform can evolve very quickly as to publishing companies, they frequently disappear. Therefore, we must be able to easily change the platform without rehabilitate contents. Linking its educational content to a particular platform would be a too great risk: We have to sustain content to deal with technological developments
- The accessibility, reusability, adaptability. We must be able to search and find resources by keywords, assemble multiple resources to form a new course, maintain and adapt contents

The typical usage of SCORM is to manage the interactions between a warehouse of learning resources and courses (called in computer science a “repository”) and an Learning Management System (LMS) is to say a learning platform responsible for disseminating these resources to learners and teachers.

The main feature of SCORM is that it defines a model of aggregation of content but also a runtime environment (Furht, 2008).

This content aggregation model aims to describe and exchange elements of training, within a warehouse of educational materials. It has three levels of metadata, which establish, for each component of SCORM, correspondence with the IEEE LOM elements:

- The first level is the component “Asset” or “Multimedia Resources”. The first level is the resource producer
- The second level is the component Sharable Content Object (SCO) or “grain of training”. The second level is the actual teaching subject: A grain executable by a browser which can be documented in the same way that the multimedia resource

- The last level is the component "content aggregation" or "courses, course". This third level is where the teacher collects all the grains to form a course and organize activities on a quarter or a year

These metadata are regrouped in catalogs or packaged with the resources they describe.

The environment part of SCORM is what allows using a course on any platform (Prpitsch and Veith, 2006).

This execution environment is operating from an Application Programming Interface (API) which is a data model for the standardization of exchange between the LMS and whatever learner's Web browser. It is a toolbox in which the computer operator goes to dig up information to the platform on the activity of the learner. For example, if stopped at half of the course, the teacher and tutor will know and the learner will be back in the right place next time.

The runtime environment provides to grains (SCO) a standard way to communicate with platforms and other applications. This hide from content creators the details of the realization of the communication interface between the grain and the running application.

If SCORM is complex due to its three levels and more content-oriented than activity, the standard nevertheless presents a number of advantages: it integrates and well complements the LOM (which was specified in the Advanced Distributed Learning (2004) (Furht, 2008)); it has no competitors and it is getting better and better supported by the platforms (Prpitsch and Veith, 2006).

IMS: In the late 1990s, appearance of open and distant learning platforms raises the question of the technical operating of learning objects with the Internet, hence the emergence of SCORM within US consortiums as AICC56. The aim is to exploit the resource in a computer system and technically monitor the use (Furht, 2008).

Ten years later, the question that exists is the integration of objects in the design of learning situations: Activities, not resources, become central (Koper, 2001). Therefore, the creation of IMS-Learn Design, that focuses on the design of devices for high quality (in educational point of view) training.

Both views have been widely criticized across the current that can be called "learning modeling language", which focuses on the staging of resources in a learning process, rather than on the resources aggregation. This trend, promoted by Koper (2001) of the Open University of Netherlands (Koper, 2001) was adopted in 2003 by IMS as "Learning Design".

The finding is: It is the learning objects that are central to the learning process but the activities associated with them (Koper, 2001).

The aim therefore is to provide appropriate models of educational design for varied learning situations (Prpitsch and Veith, 2006).

The activity is placed at the center of the process and is described as a task with a specific purpose, which is carried by a number of people who hold different roles (teachers, tutors or other), in a certain environment and relying on a number of resources, digital or not, including educational items, materials and simulations.

MATERIALS AND METHODS

XESOP-Jaxe: The main objective of the "XESOP-Jaxe" project, backed by the "Agence Universitaire de la Francophonie" (AUF), is the creation of open, collaborative and distant education through the implementation of an e-learning platform using free software based on innovative technologies of the Internet (Madjarov and Boucelma, 2006).

This objective is ensured by the establishment and sharing of digital learning content for higher education in the partner countries of South and East. This project brings support for the appropriation and transfer of technological skills for a better integration of ICT into classroom teaching and the creation of different "virtual campus" on partner sites. Based on norms and standards in force in the field of e-learning (LOM, SCORM, IMS) and making use of free software (open source), its basic purpose is to make online semantic devices for creation and management of educational resources for open and distant learning supporting training efforts relating to the administration of technology.

The basic goal includes several specific objectives involving the strengthening of human skills, the promotion of French language content, the diffusion of norms and standards for better management of teaching process favoring the selection and dissemination of open source software from the e-Learning field.

The objective can be achieved by creating interactive learning objects in a semantic development environment based on new Internet technologies, namely XML Web Services (Madjarov *et al*., 2004; 2005; Madjarov and Boucelma, 2006) considering any process of distant education as an e-Service.

The "XESOP-Jaxe" platform ensure, by a semantic structure complies with SCORM and IMS standard (Madjarov and Boucelma, 2006), the creation of learning content and building a course for the learner.

The essential elements of the project are, firstly, in semantic media for the creation, presentation and storage of learning objects based on XML technologies and on the other hand, means for managing the course of student and execution of exercises based on remote Web Services.

Other supplementary means of development and creation of various multimedia elements course content can be associated with the system according to the choices and preferences of individual partners. The space of free software offers a lot of high quality choices for the treatment and the creation of bitmap graphics, sound, simulation, tests and examinations.

In the end, the project aims to meet the needs of users in terms of tools, technology, teaching strategy and training. The success of the integration of various components in the form of e-services comes through the analysis of needs and targets of different actors.

The teacher needs consist of: Creating a multimedia educational content, the creation of individualized or typical learning course sand finally means to monitor student activities. Teachers working in a course need to share learning objects for creating, in collaboration, content best suited to the needs of a certain audience or special training.

The student needs to view online or download recommended educational content, to perform exercises that are submitted to him, to respond to offered questionnaires and to obtain an evaluation of his individualized course.

Teachers and students have common needs of mutual or group communication as topics for discussion and collaboration on common documents.

The administrator of an e-learning system installs and maintains the platform, manages access rights, creates links with external information systems (tuition, catalogs, educational resources or other).

The analysis of the needs of stakeholders in e-learning environment has led us to the conclusion (Madjarov and Boucelma, 2006): Teachers need a standardized, generic environment, linked to new technologies to promote exchanges. The design of such environment requires the existence of standards that address the structure of educational documents (LOM, SCORM and IMS).

The scheme "COURS": A course is a collection shaped as a tree of learning objects created by XML semantic publishers or imported from other systems conforming to SCORM. In XESOP design (Madjarov *et al*., 2005; Madjarov and Boucelma, 2006), this implies the creation of a courses warehouse that can be shared and searched by several educational entities. According to the course evolution, teachers may feel the need to modify the content of one or more parts of a course. Thus, the proper functioning of the collaborative system requires the storage of educational materials in a common structure and semantically defined. Using a database contributes to better reuse and disseminate these documents. So, the choice of a suitable database is critical: We opted for a native XML database that allows storage of XML documents in their original format, without transformations (mappings).

The XML document representing a course is validated according a schema that describes the structure that a course must have Fig. 1.

One course is composed by, among other things, a preface (preface), an afterword (postface) and a series of chapters (chapitres) structured as a succession of paragraphs. And, the type of content varies according to the sections: Text, figure, graph, mathematical formula or other.

The model "Projet": The model Fig. 2 we suggest revolves around four axes:

- Human resources management
- Management of material resources
- Planning management
- Assessment management

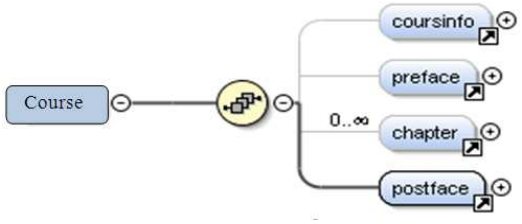

Fig. 1: Scheme of a course

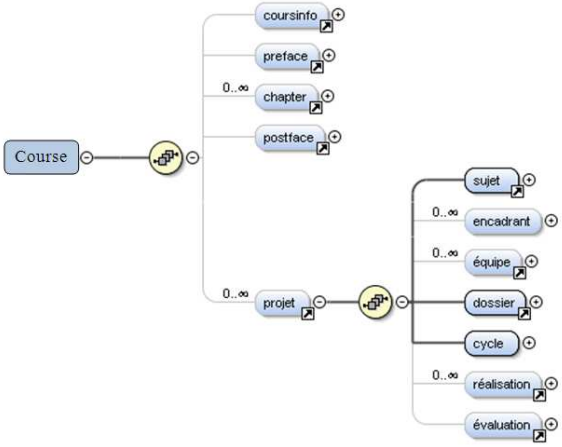

Fig. 2: Schema of an improved course with the model "projet" (project)

Regarding human resources, the model describes the role of supervisor and the constitution of teams containing several members and a coordinator. As for material resources, at first, there is the description of the project, all elements and materials available to assist the project achievement and all deliverables under each phase of the project.

Planning is described as a cycle broken down into phases, each consisting of several tasks. A task is determined in time with a start date and end date. It has a description that details the study to be done and an assignment that gives the members of the team responsible for this task.

Items handled in these axes can be shared and open to modification and validation, which is quite desirable in a collaborative study.

In terms of evaluation, the model allows to define its terms: Presentation, defense, report and demonstration.

RESULTS

A course is represented in XESOP as an XML schema. In this scheme, we integrated our model. Indeed, we grafted our model, already formalized in XML Schema, to the schema of the course while aligning certain classifications to avoid ambiguity, especially caused by polysemous terms like title, description, or date.

Thus, to the elements that could constitute a course, comes a new element called “projet” (project).

We have tested the scheme thus obtained by adding the necessary changes to the graphical interface of the XESOP platform Fig. 3.

The necessary configuration was made so that we can access all the descendants of node project whether it is in content creation or viewing.

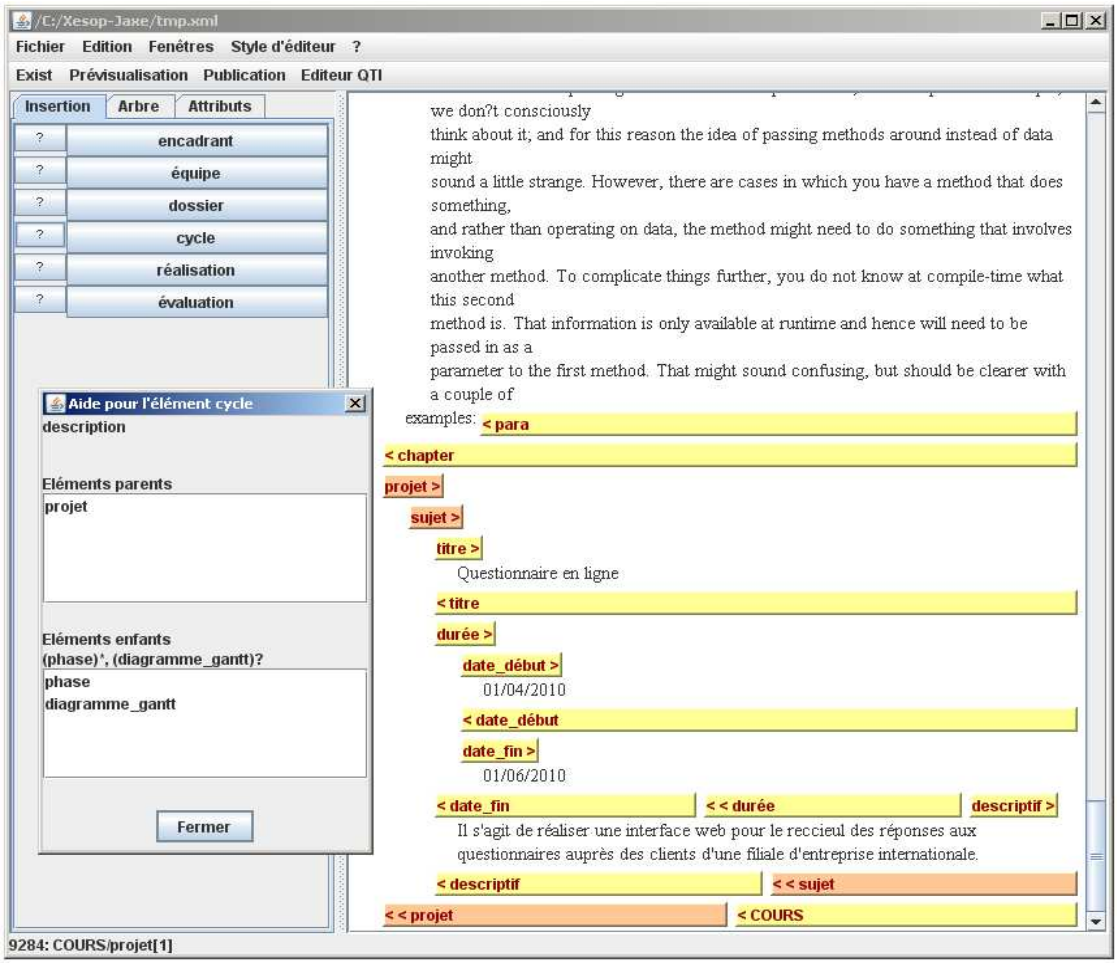

Fig. 3: The GUI after the integration of the model “projet” (project)

DISCUSSION

Such a model Fig. 2 will develop all possible scenarios in a context of collaborative work with a system of monitoring and evaluation.

A web services approach (Madjarov and Boucelma, 2006) will guarantee an exchange between different actors and give everyone the means to carry out its tasks.

The ability to store a project as it was conducted by a team may be interesting to the teacher in charge of proposing projects to be undertaken by learners in their courses. This tracking of teams achievements will result in the possibility of an analysis that will enable the teacher to fit the objectives of future projects to provide or improve their statements.

Backups may itself constitute a basis of knowledge available in the future.

CONCLUSION

The courses in certain disciplines are usually accompanied or supplemented by projects proposed to learners so that they can put into practice their knowledge and skills. However, e-learning platforms do not offer such an activity due to its complexity. We have proposed a model that formalizes an educational project, especially IT projects proposed in software engineering courses. This model was built and tested within the "XESOP-Jaxe" platform whose goal is to provide an effective solution for creating educational content in compliance with existing standards. The result is compelling and now it makes sense to think more to enrich this model by adapting methods of modeling and management of life cycle development and the agile project management methods like SCRUM (Beedle *et al*., 1998). We also think to generalize this model to cases of courses on other disciplines, other than information technology and its integration into a standard.

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