Introducing Learning Management Systems Standards in Classroom

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Abstract

Learning material reuse is a major topic in both distant learning and face-to-face teaching scenarios. This article investigates the integration in the classroom of two standards specifications – LOM and IMS LD – for interoperability of learning material between distant learning management systems. For concealing the divergence between face-to-face and distant learning contexts, we introduce LessonMapper, a visual support based on Didactic Networks, enabling on-the-fly adaptation of digital learning material to the in classroom situation. We present and discuss a three-layer structure consisting of learning objects, learning material graphs and learning design. This benefits from LOM to characterize reusable learning objects, from Didactic Networks to structure fine-grained learning material in a non-linear and adaptable manner, and from IMS LD to specify roles-oriented instructional designs of lessons.

1. Introduction

The growing number of distant Learning Management Systems (LMS) has stimulated research on systems interoperability and learning material reuse. Various standards have been published being the most relevant works the LOM [1], EML [5], and SCORM [2] standards, and the recent work done by the IMS consortium [3] that joins the previous projects. Those initiatives specify XML-based standard structures for describing the different levels of a LMS like metadata for learning objects, content packaging, content sequencing, student profile or learning design.

Those specifications have been mainly developed to support distant e-learning systems. However, currently most of the teaching/learning activities still take place in classroom. In universities and high schools, the use of computer based multimedia learning material is becoming a norm. There is indeed a lot of new computer hardware and software being used inside the classroom now like electronic whiteboards, wireless networks in combination with personal computers or PDA. For this reason the reuse of digital learning material in the classroom is also an important issue to tackle.

This article investigates the portability of metadata for learning objects and learning design standards, respectively LOM and IMS LD, in the classroom context. The couple LOM - IMS LD allows to describe the whole structure of a digital content-based course, from the basic learning objects to high-level organization. In the distant learning situation, lesson contextualization is achieved by introducing sequencing rules based on computer-based student profile evaluation. In the classroom situation, it is the teacher who is mainly responsible for doing this evaluation. However, the IMS standards do not considered this situation.

In a previous work ([4]), we argue that computer support for teaching/learning in a classroom situation stress on helping teachers to do their work without trying to replace them but rather supporting him in retrieving, presenting, manipulating and managing the right learning material in the right moment. For this, we developed a visual tool for planning, presenting and managing lectures based on digital learning material in a computer-integrated classroom called LessonMapper, based on Didactic Networks. It assists the teacher to adapt on-the-fly the lesson to the specific context and needs based on the students’ feedback during the lecture.

In this work we use Didactic Networks as an intermediate layer between learning objects and high-level learning designs. Using this architecture, we believe that the integration of LOM and IMS LD could ameliorate and popularize the reuse of learning objects and learning designs in classroom.
In the next section, we discuss the learning objects reuse in the classroom context. In the third section we suggest Didactic Networks as the adequate way of structuring learning material for boosting its reusability and we present the LessonMapper tool which helps teachers implement different teaching strategies during the lecture and change them according to the students’ reaction. The fourth section argues the need for instructional design reuse facilities in the classroom teaching-learning situation and introduces the IMS LD standard as implemented in the LessonMapper. Next, we suggest joining Didactic Networks and IMS LD. Finally we discuss the proposed architecture.

2. Learning Objects in the Computer-integrated Classroom

The introduction of computer technologies for supporting in-classroom teaching and learning activities encourages the adaptation and reuse of digital learning material. The present research trends ([6, 7, 8]) supporting teaching material publication after the class still enhance knowledge sharing and the teacher possibilities to reuse, adapt and compile existing materials when preparing the class. However, concretely reuse remains a difficult task. A key issue in the discussion about the characteristics of learning objects is their granularity. On one side coarse-grained objects that map to curriculum and integrate didactical coherence rarely provides ideal match to new context and are hard to tune. On the other side fine-grained objects are much easier to share and to contextualize but they remain definitely hard to find and require significant more effort to build-in.

In the classroom context, fined-grained objects facilitate authoring and reuse of learning material. Didactic Networks used inside a Computer-integrated Classroom (CiC) [9] is an auspicious environment for introducing fine-grained learning objects.

3. Learning Objects in Didactic Networks

Complying with McCalla’s work on self-adapting tutoring systems ([10]), Baloian et al. ([4]) introduced Didactic Networks as a way for structuring teaching/learning material in the form of semantic graphs in order to maintain coherence but giving some flexibility in the sequence the learning material is used during the lecture. They allow grouping multimedia objects references and organizing them in a non-linear manner. Researches on concept maps [11] argued that the graph structure helps to overcome the cognitive overload when displaying large amounts of information and effectively improve fine-grained learning objects management. For this reason Didactic Networks are also a valuable supports for reusable learning objects.

To support Didactic Networks authoring and use, we develop a Java prototype based on XML files called LessonMapper [4]. It was implemented as an extension of Freestyler, a visual tool for generating, presenting and manipulating active learning material ([12]). Both of them provide interface to the CiC repository in order to display, distribute and collect the learning material ([9]). Figure 1 shows an instance of Didactic Networks in the LessonMapper. Each node references a specific learning material. Double clicking on the node opens this material. LessonMapper accepts any type of material that can be opened by local applications installed on the operating system like Slide show, Web browser, Media player or Programming environment.

![Figure 1. Didactic Networks in LessonMapper](image)

Learning objects in LessonMapper are described with a subset of LOM specifications including keywords, description, activity type, format and relations with other learning objects. Metadata is characterized with visual properties of the nodes: color and shape refer to the learning objects metadata according to a customizable legend (figure 2).

The graph presented in Figure 1 deals with the implementation of a Java course using Didactic Networks. In the above example, nodes are fine grained and their description is precise. They could be one or two slides presenting a concept, an example or an exercise. They could also reference a java program, or a Freestyler collaborative learning activity. In [13], Redeker defines the most basic learning object as understandable on its own and coherent, which means without references to other learning objects. We
applied that guideline to refine the learning objects granularity without losing reuse capability.

In knowledge graphs, the link types depend on the guidance functions the system will offer to its users. Intelligent systems using a graph for knowledge representation tend to use semantic links [14]. Rhetoric links [15], on the other hand, describe the strategy or discourse used by the author to present the information represented by or contained in the nodes. Since Didactic Networks are for supporting the authoring and presentation of learning information and not giving help based on the knowledge acquired by the learning group, they use rhetorical links. For using Learning Objects inside didactic networks we propose a set of rhetorical links types: introduced by example to, introduces to, explained by, exemplified with, refined by, summarized by. Like for the other metadata, links types are visually specified with some colors that the legend recapitulates (Figure 2a).

With this feature, LessonMapper provides a visual support for the teacher to follow a specific teaching strategy. For example, the Java course shown in Figure 1 is displayed in the “Inductive learning” mode. The teacher is responsible for defining the strategy based on her own understanding of the class situation. Depending on how the students perceive her choice, she can change the teaching strategy on-the-fly and then adapt dynamically the lesson to the actual context.

4. Instructional Design in Classroom

When designing a course, teachers should focus both on content and didactic approach. However, experience shows that the emphasis is generally more on content production. The use of advanced instructional designs such as Learning by Doing, Collaborative Problem Solving or Constructivists Learning Environments [16] remains an exception. Timesaving that content reuse generates are definitely an essential step towards generalization of innovative instructional designs. Another step consists in the reuse of the instructional design itself.

There are various initiatives for encapsulating the lesson design. Most of LMS standards, like prevalent standard SCORM [2], focus mainly on the lesson structure and navigation adaptation. EML [5] and its successor IMS Learning Design [3] permit a fine description of the different steps that composed advanced instructional designs. In particular, they deal with roles definition that is essential to describe processes involved in constructivist or collaborative methods.

We propose now a subset of the IMS LD framework to support instructional design definition in classroom. It includes the base elements (method, act, role-part, activity and environment), the roles and also the objectives and prerequisites descriptions. Base elements match with the class situation as follows:

- learning design corresponds to the entire lesson
- method is the active instance of a lesson
- plays are independent parts of the lesson
- acts correspond to sections of lesson parts (for ex: specific chapter, final project, final exam) – they involve sequencing restrictions.
- role-parts are role-oriented elements of sections (for ex: student assignments, tutorials, lab assistance) – they involve sequencing or parallelism restrictions.
- learning activities and support activities correspond to activities processed by the role-parts.
- environments are the sets of services and learning material required by the activities.
LessonMapper is extended to support the previous subset of IMS LD with new types of nodes characterizing base elements, roles and objectives. Each base element is a container that accepts other components according to some specific rules. For instance, a play contains one or more acts when a role-part contains one role and one activity or one role and one learning design.

Didactic Networks as favorable settings for catalyzing and moderating on-the-fly learning material take naturally an intermediate position between fine grained learning objects and high-level structure of classroom lesson. Therefore, we merge the concepts of environments and Didactic Networks in our implementation of the IMS LD framework. Practically, in the environments definition we aggregate a list of pairs associating each learning material or service with a node on the graph.

In LessonMapper the activities are associated with one didactic network but more than one activity can share a same didactic network. For instance in Figure 3, a lab session stages two role-parts: lab work and lab support. They describe respectively the students’ activity and the teacher assistant activity inside the lab. Basically, those activities interact with each other and share the same didactic network that contains project description, basic java schemes and the solutions (with restricted access).

In a basic scenario, at the beginning of the course, teacher presents the lesson high-level structure to the class. She relates the learning design diagram with the class schedule and put emphasis on the different roles and tasks coordination. Then, she can begin the lecture by double clicking on the environment attached with the current activity. By doing this, the associated Didactic Network is displayed. When the activity is a lecture, the teacher presents the lesson as a specific learning path in that graph. This path could be at the beginning based on a plan she could expect for her lesson. The reaction of the students coupled with the teaching strategy application may make this learning path evolve putting more emphasis selecting examples, explanations and animations more carefully. In case of a reading assignment, the students will have the responsibility for browsing themselves the didactic network encapsulating the material to study. For a practical session (lab), a didactic network presents the learning material and services to be used both by the assistant teacher to introduce the problem and the students to build a solution. Legend and didactic strategy characterizing the graphs are consistent in a same lesson unit but may be customized whenever it is necessary, so that teacher and teacher assistants can continue adapting the course to the class context.

6. Discussion

This article presents LessonMapper, a tool for supporting face-to-face computer based lessons authoring, use and reuse using distant learning
facilities. We plan to focus our research on advanced visualization methods, allowing at the same time the system to support teachers in developing different teaching strategies. The upper layer is a subset of the IMS LD specifications to support learning design. The instructional plan is represented by a diagram which shows the different roles and tasks coordination. It is the transition stage between the different course parts.

Didactic Networks manage metadata and references of learning material which allows to conceal the divergence between the distant and face-to-face learning situation. Indeed, in the classroom situation teacher and student profit from critical interactions which enable significant adaptation and contextualization of lessons. The Didactic Networks were designed to support this situation. They permit to organize learning material in graphs so that the material are not fixed in the order of a predefined plan but related to the other materials as graph nodes. The application of filters on the graph display helps the teacher follow a particular didactic strategy that could be modified on-the-fly depending on the students’ reaction.

LessonMapper facilitates learning objects reuse. First, learning objects are characterized with a subset of LOM specification which permits interoperability with other learning management systems. Second, Didactic Networks support the design and use of fined-grained learning objects which are basic requirements towards efficient contextualization of reusable learning material.

In integrating the IMS LD specifications our system attempts to separate learning designs and learning material. This division is necessary to make possible the reuse of the instructional design framework.

We have tested the new features of LessonMapper on a Java course. Despite its basic instructional design, the structure visualization seems to be of notable help for the class. Our next work will aim at designing a course based on collaborative methods. For supporting the structure complexity that such methods involve, we plan to focus our research on advanced visualization facilities.

7. References

[1] IEEE Learning Objects Metadata
http://ltsc.ieee.org/wg12/