Effective Characterization of Learning Objects

Isabel Azevedo\(^1\), Eurico Carrapatoso\(^2\) and Carlos Vaz Carvalho\(^1\)

\(^1\) Instituto Superior de Engenharia do Porto,  
R. de S.Tomé, Porto, Portugal  
\{iazvedo; cvc\}@dei.isep.ipp.pt

\(^2\) Faculdade de Engenharia da Universidade do Porto,  
R. Roberto Frias, Porto, Portugal  
emc@fe.up.pt

Abstract

In this paper we describe a project that intends to develop and evaluate a model for learning object repositories. This model includes the semantic characterization of learning objects and a description of their practical use in learning and teaching practice. This way we believe it will be possible to enhance reusability. The IMS Learning Design specification has been used in this work to achieve this pragmatic characterization. For each learning object, practical examples are provided to demonstrate how they might be reused (a Creative Commons licensing scheme could be used as legal support for this sharing process).

1. Introduction

One of the main objectives of a learning object (LO) repository is the reuse of the enclosed objects. Nevertheless, although there have been a few learning object repositories with demonstrated strong usage, most existing Learning Object Repository (LOR) are often under populated and under-used [14].

According to Koper et al [9], although LO and LOR are broadly available, instructors still have great difficulties when trying to adapt or use materials available in learning object repositories. Also, Wiley [16] argues that there will be repositories that enclose lots of learning objects that nobody knows how to use/reuse if pedagogical and practical issues are not considered.

So, the reuse of an object does not happen without a careful planning that goes beyond its immediate application. An additional effort is required to design a more generic structure, more complex than the one designed for a single use. This problem is well-known in the field of Software Engineering [4].

One way to promote the learning objects reuse is the conformance to standards and specifications for describing learning objects. That makes possible a good agreement platform. But beyond this aspect, and in order to incorporate learning objects in a learning experience, a pedagogical structure is necessary to state how learning objects can be used [14].

The IMS Learning Design (LD) specification [7], released in February 2003, can be used for this purpose, stating clearly how a LO can be used.

Furthermore, the current tendency in e-learning is to go beyond contents and resources development and focus on the activities that support knowledge acquisition, during the learning design planning. The expression “learning design” refers to various forms of designing learning experiences through a sequence of activities and interactions.

On the other hand, Pedagogical Patterns capture best practice in particular educational domains [3], assisting teachers to outline strategies to surpass common difficulties and problems, like how to motivate students, how to introduce new concepts or how to sequence activities, for example. They usually are available in narrative or diagram-based descriptions and must be instantiated to be used. IMS LD can be seen as a powerful way to implement patterns. Furthermore, it is possible to achieve pedagogical flexibility using the IMS LD specification, through the implementation of diverse learning scenarios.

At the present time, there are already many tools that support this specification, like editors, players and an engine (see section 2). There are also many groups
and international research projects working around IMS Learning Design or directly related to it (as discussed in section 3). Also IMS Learning Design is endorsed by academic and commercial sectors, and it has been considered a “de facto” standard.

This paper describes an ongoing research being carried under CASPOE project. It will provide a practical context for further reuse of learning objects, giving a pragmatic description. By pragmatic we mean capturing aspects of the end use situation.

Although this work isn’t dedicated to any specific knowledge area, the initial evaluation will be done considering the results from the application in an Informatics Program, because of the background of the researchers involved in this project.

This paper is divided into six sections. The first one contextualizes the project. In the second section LD tools are characterized. Some related projects are described in the third section, especially those that might be useful for our purposes. The generic and detailed objectives of this work, and an in depth description of the project, are discussed in the fourth section. Finally some conclusions are presented in the last section.

2. LD Tools Overview

As stated before, IMS LD is used to formally describe educational processes, which are nominated Unit of Learning (UoL) by the specification. These educational processes are encoded in XML. IMS Learning Design is a complex specification but many tools have already been developed, making possible to work with IMS LD at different levels. In this section we describe some of these tools and their features.

The LD tools can be classified as higher-level or lower-level tools. The distinction between them is in the knowledge level about the specification indispensable to successfully use the tool [10]. Higher-level tools are usually considered appropriate to be used by teachers. CoSMoS is a lower and middle-level authoring tool, and ASK-LDT can be viewed as higher-level tools (see section 2.1).

The LD tools aren’t collaborative tools, although the authoring of UoL usually isn’t an individual task. Collaborative tools should appear in the future, making possible for multiple users, with different roles, to work around a learning design.

Most tools that will be presented in the following sections don’t cover all specification levels: A, B and C. Each level adds new functionalities to the previous one. Level A is the most basic level of the specification, whereas the most complete one is level C. Level B is the intermediate level that provides some personalization capabilities.

2.1. IMS LD engine

An IMS LD engine is a software application that interprets the XML notation. Usually an engine appears incorporated in a LD player.

CopperCore (http://coppercore.sourceforge.net/) is a J2EE runtime IMS LD engine. It can be incorporated in other tools, so it is very interesting for system developers, especially to player developers. When version 2.2 was released on December 2002, it was the first open source engine to provide support for all three IMS LD levels. The last version (3.1) was released at the end of March 2007 and was funded by D4LD - Developing for Learning Design project (http://sled.open.ac.uk/web/project/d4ld.jsp).

CopperCore engine supplies APIs to build user interface, but it doesn’t supply interfaces ready to use.

2.2. IMS LD editors

LD Editors are Learning Design authoring tools built around the concepts of ‘activity’ and ‘learning flow’, usually providing support to guarantee the validity of the generated document.

Reload, Ask-LDT, CopperAuthor and CoSMoS are LD editors (see Table 1). We can say that Reload is the reference editor for IMS LD. Reload and CoSMoS provide full support to edit learning design at levels of A, B, and C. Levels B and C require dealing with some technical vocabulary that doesn’t facilitate its operation in a friendly way.

<table>
<thead>
<tr>
<th>Tool Name</th>
<th>Web site</th>
<th>Author</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>CopperAuthor</td>
<td><a href="http://www.copperauthor.org">www.copperauthor.org</a></td>
<td>OUNL</td>
<td>A</td>
</tr>
<tr>
<td>Reload LD Editor</td>
<td><a href="http://www.reload.ac.uk/leditor.html">www.reload.ac.uk/leditor.html</a></td>
<td>Reload</td>
<td>A,B,C</td>
</tr>
<tr>
<td>ASK LDT</td>
<td><a href="http://www.ask4research.info/">www.ask4research.info/</a></td>
<td>University of Piraeus (iClass project)</td>
<td>A,B</td>
</tr>
</tbody>
</table>

Table 1 – IMS LD editors
LD Editors can be classified as [13]:
- Tree-based Authoring Tools,
- Diagram-based Authoring Tools.

A tree-based authoring tool presents the elements of LD aggregated in more and more specialised levels (like the branches of a tree) with a well defined hierarchy. Users can navigate through the structure and enter values for the shown elements. Some LD authoring tools that adopted a tree-based approach are Cosmos, CopperAuthor, and RELOAD.

A diagram-based authoring tool represents IMS LD elements as nodes and their relations as arrows in a graphical representation. Examples of diagram-based authoring tools are MOT+ (http://www.licef.teluq.uquebec.ca/gp/eng/productions/mot.htm) and ASK-LDT. LAMS (http://lamsfoundation.org/) is a diagram-based authoring tool.

In a tree-based authoring tool it is easy to understand the major components of a learning design, but it is easier to understand the relations between the different elements in a diagram-based tool. But with a great number of elements it can be difficult to put all of them in a diagram, being necessary to use more than one layer. Also as recognized by Miao [13], in a diagram-based tool is impossible or very difficult to use the graphical information created in different tools.

Not all diagram-based tools can be considered higher-level tools: MOT+ isn’t one.

### 2.3. IMS LD players

An IMS LD player is an application that interprets an XML file and, considering all the roles of the unit of learning, presents the activities in a sequenced order, based on the specified properties and conditions. The most popular player is SLED player, but others are available or being developed (see Table 2).

<table>
<thead>
<tr>
<th>Tool Name</th>
<th>Web site</th>
<th>Author</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>EduBox Player</td>
<td>-</td>
<td>OUNL and Blackboard</td>
<td>A, B, C</td>
</tr>
<tr>
<td>SLED Player</td>
<td><a href="http://sled.open.ac.uk/web/">http://sled.open.ac.uk/web/</a></td>
<td>OU UK and OUNL</td>
<td>A, B, C</td>
</tr>
<tr>
<td>IMS-LD Package</td>
<td><a href="http://strauss.gast.it.uc3m.es/">http://strauss.gast.it.uc3m.es/</a></td>
<td>University Carlos III of Madrid</td>
<td>A</td>
</tr>
</tbody>
</table>

Another LD player currently available is CopperCore Player, although it could also be considered as just a useful prototype to run UOL. It is not a very practical tool as it doesn’t have a user-friendly interface. It is a built-in component of the CopperCore engine (see section 2.1).

### 3. Related Projects

Several learning design repositories have appeared, based (or not) on the IMS LD specification. There is a Learning Design Repository available at http://www.idld.org, result of Implementation and Deployment of Learning Design Specification (IDLD) project, which is a Canadian project committed to the diffusion of “basic educational modelling concepts, like learning designs patterns and examples, in order to produce a repository of IMS-LD compliant units of learning”. The IDLD repository encloses a number of learning scenarios.
The European Network for Lifelong Competence Development, TENCompetence for short (http://www.tencompetence.org), is a 4 years project supported by the European Commission through the IST Programme running from December 2005 to November 2009. It has used IMS LD in the context of Life Long Competency Development. It is developing systems using IMS LD, in the context of one of its work packages that focus specifically on Learning Activities.

Also, OpenDock (www.opendockproject.org), a Leonardo programme project, is developing an IMS LD aware repository called OpenDocument.net.

Another remarkable project from the pre-IMS LD era is the Learning Designs Project [11]. This project was started in 2000 and generated “generic/reusable learning design resources”. It resulted in 32 narrative learning designs divided into five focus groups:

- Collaborative,
- Concept/Procedure Development,
- Problem Based Learning,
- Project/Case Study,
- Role-play.

It is important to note that past projects were very important for the attention gradually given to the specification and to make it reach its current use. CooperCore is an engine (see section 2.1) that was developed by the Open University of Netherlands under ALFANET project (http://alfanet.ia.uned.es/alfanet/). It continues to be the only one developed so far and it is being incorporated in many players. UNFOLD project (http://www.unfold-project.net) has many available information on IMS LD. Although the project has already finished, the repository continues up to date.

LAMS community of practice (available at http://www.lamscommunity.org/lamscentral/) maintains a repository of learning scenarios in LAMS sequence format (.las files).

It is expected that Learning Design Repositories will become increasingly popular, as the possibility to search on IMS LD properties like objectives, for example, is a very interesting functionality to provide to end users.

4. CASPOE project overview

This project has the following main goal: the semantic characterization of learning objects stored in repositories, providing a practical context for further reuse. The following activities are envisaged to reach this main goal:

- Investigate the current situation of the use and reuse of learning objects and repositories architectures;
- Describe the most remarkable projects, initiatives and tools that follow the e-learning and technological norms in the research area of this work;
- Provide a good representation of learning objects capturing their semantics and improving the quality of the annotation of learning objects;
- Provide a representation of learning objects that places contextual information not directly related to the learning object itself but to one or more specific templates related to the learning object;
- Define generic learning design templates that can be instantiated to generate specific templates for learning designs;
- Define how additional generic templates can be automatically generated.

A preliminary stage was dedicated to the theoretical background: the study of the concepts related to this project. Also in this phase, a detailed study was carried about the present state of the technology associated to each concept and related projects with outcomes to follow.

This phase is almost finished as it is still necessary to track new initiatives that will certain emerge or some others that are in a very preliminary stage as the work on the IMS Common Cartridge specification [6]. It should be important to this research as the “Common Cartridge will define a commonly supported content format, able to run on any compliant LMS platform”, but at this moment it is too early to evaluate its suitability.

Our initial model has six major components as can be seen in the next figure:
The components Domain Ontologies, Learning Object Characterization and Learning Object Taxonomy are mainly related to the task described in section 4.1, while the others are related to the task “Pragmatic characterization of learning objects”, which is explained in section 4.2. Another important task, “Development and evaluation of a prototype”, is described in section 4.3.

4.1. Semantic characterization of learning objects

The scientific community discusses the lack of a plain widely accepted definition of learning object [12]. The use of a learning object taxonomy should accommodate the different definitions considered by diverse authors.

It seems clear that it is necessary to define a taxonomy that aggregates the possible desired definitions.

Also, due to the domain-specific characteristics of educational materials, it is necessary to annotate them with domain-specific information, in order to improve their use and reuse.

A learning object has to be described according to the taxonomy and to one or more domain ontologies and it is necessary to define the mechanisms to do that. The metadata schema at the Learning Object Characterization module is based on the IEEE LTSC Standard for Learning Object Metadata (IEEE LOM) [5]. This standard was approved in June 2002 and since that time LOM metadata and application profiles based on IEEE LOM standard have been largely used in repositories [14].

An application will be developed to generate, as autonomously as possible, a domain ontology from a set of documents about the same subject, with some expert support. Also, using software agents, it is necessary to assure that the domain ontologies remain valid, as knowledge domains aren’t static ones: new topics and relationships may emerge along the time.

It is necessary to verify the quality of the generated ontologies against high quality hand-built ontologies of these domains.

4.2. Pragmatic characterization of learning objects

Templates and patterns will be maintained by the Generic templates and patterns module. We consider templates almost ready-to-use scenarios, while patterns are pieces of learning scenarios that can be put together to create a learning design. They are defined a priori to support different pedagogical approaches and catalogued for further future use to provide a practical context for learning objects. Some projects identified in the previous section will be a good source of materials to be worked out. These materials will have to be kept as close as possible to the IMS LD specification.

Diverse authors [1], [8], [15] claim that learning design ontologies are required mainly because:

- They allow the formal definition of the semantic constraints of the LD concepts;
- They make possible to provide a knowledge base for any IMS LD compliant authoring systems/LMS, providing services to authors of LD scenarios;
- They can enhance the level of reusability of learning designs.

For this project the use of a learning design ontology is especially important to validate the context examples.

Using the generic learning designs and the semantic characterization of the learning objects, it is necessary to provide mechanisms to make possible the definition of practical examples for each learning object. How to generate an example of utilization for a learning object using the learning object itself and a predefined set of generic learning designs is an issue that has not been addressed yet in any project, but this is an important step. One possibility is the use of an educational taxonomy considering the knowledge dimension (factual, conceptual or procedural) of the learning object. Some information from authors may be necessary but it is not reasonable to expect them to
spend a lot of their time in this task, so it is necessary some way to automate as much as possible this process.

4.3. Development and evaluation of a prototype

In this phase, a prototype will be developed using the described modules. The achieved results will be analysed in order to demonstrate the initial hypothesis: it is possible to have a semantic and pragmatic representation of learning objects, which can improve their reuse.

So, the main planned activities are the following ones:

- Develop the prototype;
- Test and evaluate the prototype in real environments.

All developed software and documentation will be available under GNU General Public License (GPL), while developed educational materials will be available under a Creative Commons License [2], which provides a legal basis suitable for reuse of learning objects.

5. Conclusion

We described the motivations for the project and the importance to study and develop frameworks that state how learning objects can be used, relating them to practical usage.

We also discussed LD tools and projects working around IMS LD. The number of discussed items shows that it is a promising specification. Also it has been adopted by well-know learning platforms, like LRN (http://www.dotlrn.org) and Moodle (http://www.moodle.org – still in progress), reinforcing our belief that it will be largely adopted in the upcoming years.

This paper discussed an ongoing work presented in detail in the fourth sections, that aims to semantic and pragmatic characterize learning objects, making sense of the expression “reusable learning objects”, but also contributing to a new one: “reusable learning designs”, using IMS LD to achieve the pragmatic description of learning objects.

Hopefully CASPOE project will help to improve the reuse of learning objects, pointing a possible direction. The field of the Semantic Web has been growing in the last years, but another field, Pragmatic Web, is gathering more and more attention from the scientific community. The concept of pragmatics is related to contexts of usage. In this research work both fields will be joined.

6. Acknowledgement

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7. References


