Learning Design Repositories – Structure Ontology and Processes

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Abstract

We summarize here the results of a project called IDLD:Implementation and Deployment of the Learning Design specification. The main product of the IDLD project is a portal that provides a suite of tools and methodological aids to help build IMS-LD compliant learning designs. In this paper, we focus on a practical approach to build and extend a repository of learning designs. We present a more specific process where tools in the portal serve to extend the repository by building LD patterns extracted from an actual course, recomposing them into new patterns and new courses. We present a LOM-based LD classification scheme to help structure the repository. Finally, we present part of an ontology to improve the structure, and hopefully the usefulness, of the LD repository.

Key Words

Learning Design, Learning Object Repositories, Learning Design Methodology, Instructional Design, Learning Standards.

1. Results from the IDLD project

The deployment processes of a new technology or a new methodology are crucial for R&D results to reach users as innovative products and services that can produce quality and growth. These preoccupations are at the origin of the IDLD project, a continuation of our work in the R2R project [12]. The main results of the project are grouped is the IDLD Resource Center, a Web portal now in operation at www.idld.org providing access to a repository of learning designs, a suite of tools to support the deployment of IMS-LD, methodological aids to help in its implementation and a number of background documents and related sites.

The LD repository

Building LD repositories has been identified as a priority in a Valkenburg Group round table held in January 2004 [11].

The central resource of the portal is the LD repository. It contains actually a limited number of entries but it gives access to different kinds of products of the learning design implementation process: initial narratives of learning scenarios, graphic models of learning designs, IMS-LD compliant XML manifests and some learning designs embedded in complete on-line courses. The graphical models and their corresponding XML manifests are either LD examples, where the content resources are specified as items, or LD patterns that are design flows without specific content.

We believe that LD patterns are more interesting that other types of learning objects because they are ready-to-adapt multi-actor processes embedding learning and teaching strategies that can be reused in different knowledge domains. When a critical mass of LD patterns will be made accessible, we can expect a greater use of such repositories than content-specific ones.

Methodological aids to IMS-LD

Besides basic IMS-LD documentation, the IDLD portal offers a set of new methodological aids to instructional designers and educators involved in the implementation and deployment of IMS-LD

- A methodological guide to support IMS-LD authoring, validation and execution using the above tools or other alternative tools;

- A description of the classes of learning designs in the classifications we have used to provide metadata descriptors for learning designs;
- A set of best practices in the development and use of the learning design repository based on our experience in the project;
- A workflow model to help build units of learning or courses compliant with the IMS-LD specification.

A Suite of LD Tools

To support the development and use of the LD repository, the IDLD portal presently offers four tools:

- the MOT+LD graphic editor [10] that supports an interactive design process more friendly to designers than form-based editors, but limited to level A of the IMS-LD specification;
- the RELOAD editor [14] supporting A, B and C levels, but in a hierarchical form-based format;
- the RELOAD player, embedding the COPPERCORE [5] engine, that reads IMS-LD manifests and offers a Web-based interface to deliver and execute a LD run;
- PALOMA, a learning object repository management system (extracted from the Explor@ system [13]) that supports the IEEE-LOM and the IMS-DRI specification for federated search into multiple repositories.

These tools are sufficient to support the implementation process presented below; however, some limitations appear and we aim to extend this tool set with other open source tools that are being developed by us or other groups, particularly by partners of the LORNET research network (www.lornet.org).

In section 2, we will present how we have used the IEEE-LOM to structure the LD repository, in particular adding two classifications schemes into the PALOMA tool. In section 3, we will present a process for decomposing a course LD into smaller patterns and recomposing some of them into new courses. In section 4, we will propose an ontology to extend the LOM for structuring the repository and making more meaningful queries.

2. Classification of learning designs

To facilitate search in learning object repositories containing learning design products we needed to classify the LDs according to their main properties.

Figure 1 shows such a classification embedded in the PALOMA learning object manager. The left part presents a list of available repositories, including the IDLD repository; the center part shows a list of designs grouped in one repository; the right part is the section to creating, modify and view a standard IEEE-LOM record for the selected object. Here, this object is a learning design for a collaborative LD pattern entitled "FORUM SYNTHÈSE".

For this LD, the user has selected metadata from the learning design classification: the delivery model is "Asynchronous Online Training", the pedagogical strategy is "Debate/Discussion", and the evaluation model is "summative", based on "learner productions" that are "mostly individual". These three top level categories of the learning design classification are extracted directly from the MISA method, an extensive work on instructional design methodology started in 1992, based on educational theories and knowledge/software engineering [2,8,9].

Category A400 of the classification specify a level of reusability of a learning design on different aspects, extending [1]. Since the LD here is a pattern, it is considered to be "technology independent", "content generic", "context-of-use independent" and "adaptable to certain disabilities". Finally, category A500 describes the type of LD product, in this case an IMS-LD Graphical Model.

In the list of classification descriptors on figure 1, we see that the last entry shows metadata from another classification scheme on cognitive skills and strategies, also extracted from our work on MISA [7,10] and integrated in section 9 of the LOM. For the example, this metadata indicates that the learners will use and develop synthesis skills. We have discussed elsewhere why such generic skills and strategies are fundamental to structure learning design strategies.
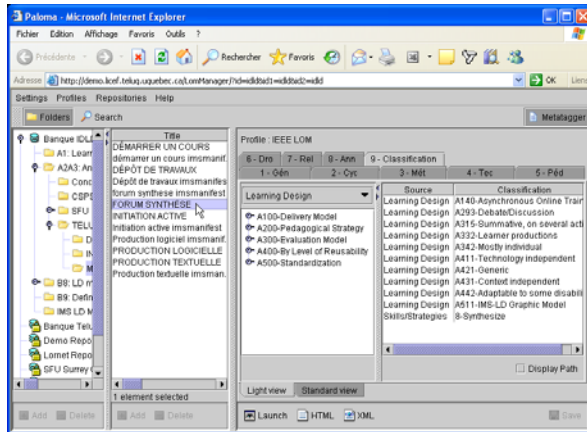
Figure 1 – Learning design classification and metadata association to learning designs

Other LOM entries are useful to provide some semantic structure to the set of LD products in a repository. We use the 1.8 section of the LOM to specify one of four aggregation levels:

1. Raw media (learning objects and services);
2. Lessons (grouping level 1 objects);
3. Courses (grouping level 2 objects);
4. Programs (grouping level 3 objects).

Section 7 of the LOM provides a limited set of choices for relations between learning objects LOM descriptions. We used some of them with the following semantics:

- "is basis for /is based on" indicates the relationship between a narrative or a textual course outline (or course plan) and a graphical model or an LD manifest;

- "has format/is format of" indicates the relationship between a graphic model of a UoL, an IMS-LD manifest or an executable Web version of the same UoL;

- "has part/is part of" will indicate the relationship between a LD product and its components, for example, between a level 3 (course) and a level 2 (lesson) object.

- "has version /is version of" is re-interpreted as the relationship between a pattern and its examples obtained by associating precise items to the abstract objects (environment, activity, role,…) in a LD pattern.

3. Processing Learning Designs

We now use the metadata presented in section 2 to describe various LDs obtained by graphic operations on an existing course. Figure 2 shows part of an OWL-DL ontology [6] in graphic MOT+OWL format that we will present further in section 4. The (I) link is the standard instantiation link between a class (here the LDs obtained from the same INF-5100 course) and one of its individual.
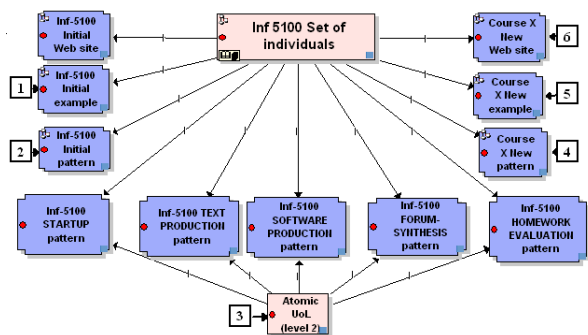

Figure 2 – Part of an ontology for a LD repository: a class of related Learning Designs

The numbers on the figures show the order of operations in a decomposition/aggregation process that was applied to an existing course on Artificial Intelligence at Télé-université labelled Inf-5100.

(1) The course was first modeled using the MOT+LD graphic editor as an IMS-LD Unit of Learning that was integrated in the IDLD repository.

(2) Using this editor, the model was stripped of its content by deleting all items to obtain a level 3 pattern, which was also added to the repository.

(3) This pattern was then decomposed into five level 2 "atomic UoL" patterns, each added to the repository.

(4) Using these level 2 patterns as activity structures, a new level 3 pattern (Course X) was aggregated and added to the repository.

(5) Content items have been added to this level 3 pattern to obtain a new level 3 course in political science. The corresponding manifest was generated and referenced.

(6) This new manifest was executed by the RELOAD player to deliver the new course.

These operations deserve some explanation that will help the reader understand how we have processed learning design graphically. Figure 3 shows the initial course play comprising eight acts. Each have sub-models (not shown on the figure) composed of roles, environments and activity structures. Act 1 sub-model is simple enough to be stored in the repository as one reusable activity structure, the "START-UP pattern" in step 3 of figure 2. Act 3, 5 and 6 are the same, stored as the "HOMEWORK EVALUATION pattern".

From Act 2, 4 and 6 sub-models, we have extracted two recurrent activity structures called "TEXT PRODUCTION pattern" and "SOFTWARE PRODUCTION pattern". Finally, act 7 yields the "FORUM-SYNTHESIS pattern" whose metadata have been described in figure 1. In MOT+LD, these sub-models are simply copied to a new LD structure and stored in the repository using PALOMA.
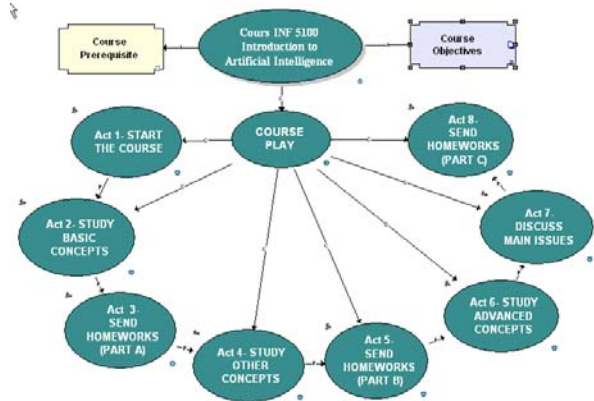

Figure 3 – The initial course

Afterwards, we search and retrieve these "atomic patterns" to group them in different plays and courses.

4. An ontology to manage the LD repository

To describe the relations between these different LD products, we have built a LD ontology to structure the repository. It embeds the classification, granularity level and relations described in section 2.. Figure 4 present the upper part of this ontology in MOT+OWL format. Classes are represented by rectangles and properties by hexagons. Here the graph shows the different section of the LD classification

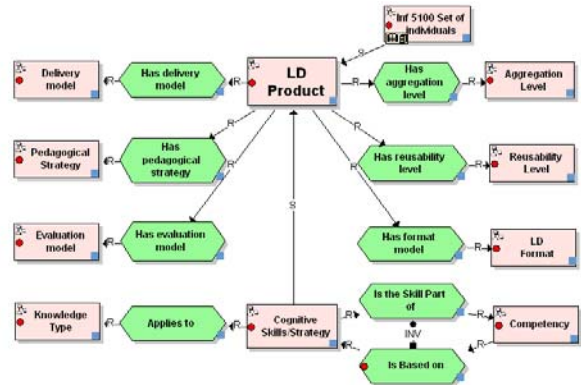presented earlier with some added details for the central Cognitive Skills/Strategies sub-classes.

Figure 4 – A LD-products top-level ontology

On figure 5, the subclasses of the "LD format" classes and their main relationships are shown. A complete description and justification of this ontology is of course out of scope here.
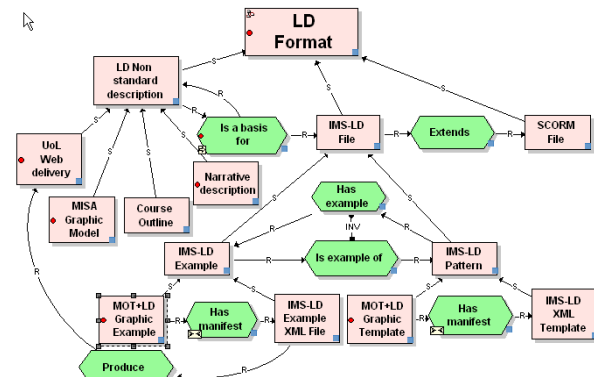

Figure 5 – The LD format sub-ontology

To this ontology we can add constraints that would enable users to avoid erroneous descriptions such as a so-called "synthesis" LD decomposed into UoLs that are all at the "apply" level. Using an inference engine on this ontology we expect to be able to query the LD repository in more meaningful ways than is possible now.

Conclusion

While populating the LD repository using the process in section 3, the graphic MOT+LD editor was found very helpful. It is easy to transform graphs, extract sub-graphs or regroup them, then add content items to create new learning designs.

Some problems occurred during the process. The new courses obtained by aggregating external UoLs must respect IMS-LD constraints that can be relieved in the graphic format. For example, items and environments can be added automatically by the graph parser into the manifest, thus easing the designer's task.

It is complicated and time-consuming to establish links between resources using PALOMA or any LOM manager. A specific interface can be built to aggregate together the LD editor and the LOM manager, both to add metadata to the LD components as specified by IMS-LD, and to describe LDs globally as learning objects as we have proposed here.

Automating the metatagging process can be made easier if we deduce metadata from the regular structure of an IMS-LD manifest and the proposed structure for a LD repository. For this a well-researched ontology must be shared by groups involved in LD research and deployment.

The IDLD repository has been built by the CICE team at the LICEF research center in Montreal with the collaboration of other Canadian researchers at Concordia University in Montreal, Simon Fraser University in Vancouver and the University of Waterloo in Ontario who have provided learning designs for the repository, as well as using and validating the tools. All the resources included are in the public domain using eCommons licenses. Télé-université is committed to sustaining the portal, hoping that new partners will make contributions to it or work with us on the issues presented here.

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