Introduction to IMS Learning Design

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Introduction

Since the publication of the IMS Learning Design specification in February 2003 (LD, 2003) various parties around the world have been active to develop tools, to experiment with Learning Design in practice, or to do research on the further advancement of the specification. The European Commission 6th Framework Project UNFOLD (2004), organised a platform for these parties to meet each other, to exchange ideas and to discuss future developments of Learning Design and Learning Design tools. Many things have happened in 2004 and 2005 that provides the building blocks for future implementations. To mention just a few, starting with the main publications in the last year:

- Just before the UNFOLD project started, a group of persons in the field wrote 22 chapters for a book about Learning Design (Koper & Tattersall, 2005) that became available in February 2005. The book contains 22 papers about the specification, architectures for tools, descriptions of tools, examples and methodologies for the design of e-learning courses and (preliminary) experience with IMS Learning Design, including the experience at the Open University of the Netherlands with its predecessor Educational Modelling Language (EML, see Koper & Manderveld, 2004).
- The special Issue of the Journal of Interactive Media in Education (Tattersall & Koper, 2005) has been published as a result of UNFOLD activities. It contains 17 papers that are reflections or updates of the learning design book chapters.
- Furthermore a special issue of the IEEE Journal Educational Technology & Society (http://www.ifets.info/others/) has been established that will be published in December 2005. It contains 12 papers about Learning Design that provides an overview of current research in the area. These will be summarized later.
- Besides these highlights of publications, many more papers have been published by many authors around the world in a variety of journals and conference proceedings (eg, search for “IMS Learning Design” in scholar.google.com).
- Many tools have been developed in 2005: editors, runtime engines and player environments. This will be discussed later.
- First examples that can be downloaded to test Learning Design has been created, using the new tools.
- And, last but not least a large and stable community has been developed around the specification to support its adoption.

In this introduction to the Learning Design Booklet I will shortly introduce the IMS Learning Design specification and will summarize some current issues in Learning Design.

The Learning Design Specification

The IMS Learning Design specification aims to represent the 'learning design' of 'units of learning' in a semantic, formal and machine interpretable way (Koper & Olivier, 2004). A 'unit of learning' can be any instructional or learning event of any granularity, e.g. a course, a workshop, a lesson or an informal learning event. A 'learning design' is defined as the description of the teaching-learning
process that takes place in the unit of learning. The key principle in learning design is that it represents the learning activities and the support activities that are performed by different persons (learners, teachers) in the context of a unit of learning. These activities can refer to different learning objects that are used during the performance of the activities (e.g. books, articles, software programmes, pictures), and it can refer to services (e.g. forums, chats, wiki's) that are used to collaborate and to communicate in the teaching-learning process.

The IMS Learning Design specification is developed to meet some specific requirements:

1. **Completeness**: The specification must be able to fully describe the teaching-learning process in a unit of learning, including references to the digital and non-digital learning objects and services needed during the process. This includes:
   - Integration of the activities of both learners and staff members.
   - Integration of resources (learning objects and communication/collaboration services) used during learning.
   - Support for both single and multiple user models of learning.
   - Support for mixed mode (blended learning) as well as pure online learning.

2. **Pedagogical expressiveness**: The specification must be able to express the pedagogical meaning and functionality of the different data elements within the context of a Learning Design. While it must be sufficiently flexible to describe Learning Designs based on all kinds of pedagogies, it must avoid biasing designs towards any specific pedagogical approach.

3. **Personalization**: The specification must be able to describe personalization aspects within a Learning Design, so that the content and activities within a unit of learning can be adapted based on the preferences, portfolio, pre-knowledge, educational needs and situational circumstances of users. In addition, it must allow the designer, when desired, to pass the control over the adaptation process to the learner, a staff member and/or the computer.

4. **Compatibility**: The specification must enable learning designs to use and effectively integrate other available standards and specifications where possible, such as the IMS (imsglobal.org) and IEEE LTSC (ltsc.ieee.org) specifications.

Because a Learning Design specification extends existing specifications, it also inherits most of the more general requirements for interoperability specifications and standards, more specifically:

5. **Reusability**: The specification must make it possible to identify, isolate, de-conceptualize and exchange useful learning objects, and to re-use these in other contexts.

6. **Formalization**: The specification must provide a formal language for learning designs that can be processed automatically.

7. **Reproducibility**: The specification must enable a learning design to be abstracted in such a way that repeated execution, in different settings and with different persons, is possible.

The IMS Learning Design specification consists of several components. First of all it consists of a conceptual model (an ontology) for the description of teaching-learning processes. This model is expressed as an UML model (see figure 1).
In essence the model says that learners perform a set of learning activities using learning objects and services (to be found in the activity environment) in order to attain some explicit or implicit learning objectives. As a result of the activities, the learners produce outcomes (e.g. reports, forum/wiki contributions, etc.) that subsequently can be used by others in their learning or support activities (e.g. a teacher can provide feedback to a report written by a learner). Teachers, other staff members or peers can perform support activities to help learners when needed. The design can be static or adaptive, taken into account the existing competencies, needs and circumstances of the persons involved.

The second component of the specification is the Information Model. This document specifies exactly how the entities in the conceptual model relate to each other. Furthermore it contains a description of the expected behaviour of runtime systems. The information model is the core document of the specification.

The third component of the specification is the Best Practices and Information Guide. This guide specifies some use cases and (expected) best practices.

The fourth component is called a ‘binding’, that is the technology used to represent the information model. The learning design specification is delivered with several bindings: a series of UML diagrams (Vogten & Verhooren, 2002), an XML schema (see figure 2) and XML DTD's. The UML diagrams were created from the initial DTD. The tables in the information model and the XML schema's were automatically generated from the UML diagrams.
The result of this all is that a teaching-learning process can be codified into an XML file with references to the learning objects and services needed to perform the activities. In practice, IMS Learning Design is used to create a zip-file using the IMS Content Packaging specification (CP, 2004). This zip-file can be exchanged and interpreted by any learning design aware runtime engine. This engine will manage the workflow ('activity management') by presenting all the actors with adequate activities and resources at the right time in the teaching-learning process.

For instance, when the design of a unit of learning is as follows:

1. Learners discuss a problem with each other, analyse it and search for background information.
2. Learners discuss possible solutions and decide upon a preferred course of action. This is written into a report.
3. The teacher reads the report and provides formative feedback: additional resources to look at, identifies problems with the proposed solutions.
4. The learners correct the report and send it in for grading.
5. The teacher grades the report.

In this design there is a sequential ordering of five activities. Each person within a learner group will get the first activity; this can be something like this:

**Activity Description:**
Attached you will find a problem that you have to solve in collaboration with your fellow students. Discuss the problem with your fellow students (e.g. using the forum or in a class room). Search and study material that you think is necessary for the solution of the problem (using the library and/or Internet resources).

**Environment (learning objects and services):**
- Problem
- Forum
- Internet Resources

The result of the second activity is that the learner group will produce a report (outcome). The teacher will be notified that the outcome of group X is available and s/he will get the support activity to
provide feedback to the report. When the teacher has provided the feedback, the learners will be notified and get learning activity 4. When activity 4 is completed, the teacher is notified that the report is send in for grading. The learners again will get a notification of the teachers grade.

Roadmap for Learning Design Implementation

It is good to notice that IMS Learning Design is nothing more or less than the set of aforementioned components: some documents and some bindings. Before the specification can be used in practice, several tools have to be developed: authoring tools, content management systems and runtime environments. The roadmap for the practical implementation of Learning Design was defined as follows (Koper, 2004):

1. Specification (February 2003)
2. Awareness Raising (February 2004)
3. First generation of tools (February 2005)

At the time of writing it is October 2005. Where are we now in this roadmap? In the period 2004-2005, the European Commission funded the project UNFOLD (2004) to support the co-ordination and dissemination of Learning Design activities. The project was highly successful: many meetings were organised throughout Europe. The participants came from all over the world. People presented their work to each other, were trained to use the newly developed tools, tested the interoperability of tools, discussed the design of new software and informed each other about new plans. In conjunction to this, the EU funded the TELCERT project (2004) that is working on application profiles and conformance tests for a variety of specifications, among which Learning Design. The results should be delivered in 2006. Also the EU project PROLEARN (2004) has the coming years some work packages that are directed to IMS Learning Design. Outside Europe, the Canadian LORNET project (2004) is, among other things, working on learning design ontologies and authoring environments. Besides these large scale funded R&D projects, many smaller projects, e.g. PhD research work, is executed at the moment all over the world. Some of the work is reported in this special issue.

The first tools indeed appeared in the beginning of 2005. At the moment there are more then 20 different tools available (see Griffiths et al., 2005 for a discussion and overview). Several authoring environments are available that support the development of the learning design XML files and zip-files. To be mentioned are Reload (2005), MOT+ (Paquette et al., 2005), Ask-LDT (Karampiperis & Sampson, 2005) and CopperAuthor (2005). Furthermore there is the CopperCore engine (Vogten & Martens, 2005; Martens & Vogten, 2005) that can interpret and set up learning design files. CopperCore however does not provide a user-interface (a so-called 'Learning Design Player'). A player adds a user-interface, but also integrates services (chats, forums, etc.) that are referred to in the learning design. Furthermore it includes an administration module to import/export learning design packages, to create a run of a unit of learning, to add persons, to put persons in the correct roles and to connect to external systems (e.g. student administration, portfolio systems, etc.). There are several prototypical players available, but most of them are still too underdeveloped to use in actual practice. Also several integrated systems (Alfanet: Van Rosmalen et al., 2005; LAMS: Dalziel, 2003) are available, however these are or very prototypical (Alfanet) or do not yet conform to the IMS Learning Design specification (LAMS). Last but not least, there is a growing set of examples and test units of learning available at moodle.learningnetworks.org that can be used to demonstrate the different possibilities of learning design. The challenge for the coming period will be to build a player and to integrate some of the tools into a platform that can be used to use learning design
courses in actual practice. Given the enormous amount of activity in the field, we can expect that this will be realised in the next year. One factor of importance will be a new large EU funded project, called TENCompetence (2005) that will have as one of its main tasks to build an open source learning design platform that can be used in lifelong competence development. Further dissemination activities will be co-ordinated, among other initiatives, through the PROLEARN (2004) network of excellence in professional learning.

**Current Issues in Learning Design**

As stated in the introduction, there are several topics that are of major interest at the moment. These were analysed in the editorial of the special issue of the IEEE Educational Technology & Society journal, and can be summarized as follows:

1. **The use of ontologies and semantic web principles and tools to:**
   a) create a new, and more precise binding for Learning Design;
   b) integrate learning objects and learning designs;
   c) to represent specific pedagogical approaches (learning design knowledge);
   d) to build software agents that operate on the learning design knowledge to support in the development of units of learning.

2. **The use of learning design patterns:**
   a) to support learning designers to develop specific learning designs (e.g. collaborative designs, adaptive designs);
   b) that are automatically detected (pattern recognition) in Learning Design coded units of learning;
   c) to capture best practices and learning design knowledge (relates to ontologies ad c and d).

3. **The development of Learning Design Authoring and Content Management Systems, including the following issues:**
   a) The development of a (standard) graphical notation for learning designs;
   b) How to support the reuse of Learning Design Knowledge and Learning Design Packages;
   c) The development of learning design specific tools to support teachers in a specific context;
   d) The question how learning designers should be supported with tools and how teachers should be supported with tools (the teacher as a designer);
   e) The integration of learning design and assessment editors in a single authoring environment.

4. **The development of Learning Design Players, including the following issues:**
   a) How to integrate the variety of specifications (eg, IMS LD, IMS QTI, SCORM, IMS LIP) and the connections to other systems in an e-learning infrastructure (student administration, portfolio systems, financial systems) into a single, easy to use learning environment.
   b) How to instantiate and integrate communication and collaboration services that are called by a Learning Design. Eg, forums, wiki's, chats; are generic service oriented architectures suitable to do the job? At what costs?;
   c) How to design a usable, powerful and flexible user-interface for a Player environment?
   d) How to integrate Learning Design into existing Learning Management Systems (like Moodle, Blackboard and LAMS)?
   e) How to integrate Learning Design Authoring Systems and Learning Design Players, including the question how to deal with runtime adaptations?

5. **How to use an integrated set of Learning Design tools in an integrated way in a variety of settings (e.g. in universities, training, blended learning).**

**Conclusion**

In this paper, the IMS Learning Design specification is shortly summarized, a roadmap is presented
for its implementation and current issues in research, development and implementation are specified. In the references you can find a variety of resources that you can read or use to know more about IMS Learning Design. The specification is considered to be of enormous importance to the e-learning field, because it offers the functionality to create simple and advanced course packages that do more then presenting some sequenced content to learners. The IMS Learning Design specification is needed to create interoperable, flexible, effective, efficient and attractive e-learning courses that are heavily needed today. However, we are still somewhere halfway on the roadmap for real implementations: user friendly tools and good practices involving real users have to be developed the coming years.

**References**


