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The UNFOLD Project. Understanding and using Learning Design

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The UNFOLD Project

Understanding and using Learning Design

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INTRODUCTION

Josep Blat
University Pompeu Fabra

The **UNFOLD** project was born in January 2004, to support the adoption of open eLearning standards catering for multiple learners and flexible pedagogies, our focus being IMS Learning Design (IMS LD).

We have provided access to resources through the site http://www.unfold-project.net, where you can find news, documents, information about events, links, ... while http://moodle.learningnetworks.org is the site for Learning Network for Learning Design-LN4LD (OUNL, 2004) housing more structured materials with (learning) activities and forums.

Our main and distinctive activity has been to support and facilitate Communities of Practice (CoPs) – teachers, learning providers, system developers–. To this end, we have organised meetings (both face to face and online) and workshops to stimulate the activity of people, suggesting themes, encouraging collaboration, ... We have also attended conferences and other events.

Shortly before the end of the two years life of the project this booklet appears as another resource for IMS LD, and reflects the key contributions made

towards implementation and adoption made by the people who have come together in **UNFOLD**
The development of Open Source reference tools for IMS LD has taken longer than expected. An "engine", Coppercore, became available late in 2004, and Reload, an editor covering the three levels of specification, by mid 2005, along with a number of other tools specifically designed for IMS LD. It is also very encouraging that other tools with origins in different contexts have been or are being adapted for IMS LD interoperability, as this is a key goal of the specification.
The concepts which underlie IMS LD provide a means for communicating and exchanging learning designs, and indeed teachers and learning designers did not wait for the tools to be fully available before embarking on debates about the expression of different pedagogies through patterns or templates. Implementation of these patterns or templates in tools which are easy to use and interoperable holds the promise of improved support for the work of teachers in all learning contexts. On a more practical level, model Units of Learning (the technical IMS LD means of expressing learning designs) have been provided. These range from elementary examples providing support for IMS LD newcomers, to more complex exemplars which represent examples of effective practice which can be reused.

All this activity has helped to map out the limits of the use and expressivity of the specification, and set the scene for possible revisions and extensions.
The **UNFOLD** project are very thankful to the high number of participants-contributors from the different countries of Europe, and around the world, a number of whom have sustained their engagement throughout the project.
We are proud to have been able to support and encourage this activity to the best of our ability.
As **UNFOLD** Project Manager, my thanks go to the other partners, Open University of The Netherlands, The University of Bolton, and EUCEN. All of us thank David (Dai) Griffiths who has provided tactful but focused coordination.

ACKNOWLEDGEMENTS

The **UNFOLD** Project would like to thank all the project partners and participants in the many activities carried out in 2004 and 2005. In particular, we acknowledge the contribution of:

Ana Días, Bill Olivier, Carmen Royo, Chris Kew, Colin Tattersall, Davinia Hernández, Gemma Corbalán, Hans Hummel, Howard Spoelstra, Jeroen Storm, José Luis Santos, Josep Blat, Lisa Corley, Mieke Haemers, Nidia Berbegal, Oleg Liber, Rob Koper, Sergio Sayago, Sheila MacNeill, Toni Navarrete.

Over 20 projects, over 20 tool developers, over 50 industrial organisations, over 300 individuals, and around 600 online participants who have generously contributed to the UNFOLD Communities of Practice events and network.

The Technology Enhanced Learning Unit of the Information Society Technologies in the 6th Framework Programme of the European Commission, who have funded the UNFOLD project.

PROJECT PARTNERS

The **UNFOLD** Project comprises four partners: The University of Pompeu Fabra, Open University of the Netherlands, The University of Bolton and the European Continuing Education Network.

Universitat Pompeu Fabra is the coordinating partner of **UNFOLD**, and their participation in **UNFOLD** is being carried out by the **Grup de Tecnologies Interactives**. They have extensive experience in eLearning, and in the production of both CDs and on-line systems. In the SCOPE project they implemented Units of Learning using EML, and they have also worked with other IMS specifications, including an editor for IMS QTI lite.

Open University of the Netherlands (OUNL) was the creator of EML over a three year R & D programme and was closely involved in the development of the Learning Design specification in IMS. They also set up and run the Valkenburg Group, formed in March 2002 with the aim of bringing together institutions and organisations from across the world actively engaged in producing EML and now also Learning Design related authoring tools and content management tools.

The **University of Bolton** is home to **CETIS**, which represents UK higher-education and further-education institutions on international learning technology standards initiatives. They have been closely involved in the specification and adoption by IMS of the Learning Design standard. CETIS also run eight successful Special Interest Groups and Forums that support practitioners in the UK. These provides the experience and forms the basis for the proposed communities of practice. CETIS also provides the foremost website on eLearning standards .

EUCEN was founded in 1991 and is now the largest European multidisciplinary network in University Continuing Education. It is registered in Belgium as an international non-governmental non-profit making organisation and has 189 members from 38 countries.

Additional information available at:

www.upf.edu and www.tecn.upf.es/gti
www.ou.nl
www.bolton.ac.uk
www.eucen.org

READING GUIDE

The first part of this booklet describes the basics of the **UNFOLD** Project, its definition, goals and the activities which it carried out up to December 2005. A second section offers a condensed overview of IMS Learning Design, which is the main current specification on eLearning addressed by the project. A final section provides a detailed and categorised list of web links, resources, books and articles.

If you are new to Learning Design, IMS LD and eLearning specifications and would like a general introduction, together with some more detailed aspects which can help you extend your understanding, we recommend that you read the whole booklet in sequence, from the first to the last section.

If you already know something about IMS LD and you want to achieve a deeper knowledge we suggest that you read section 2 and then make use of the references in section 3.

If you would like to learn about the **UNFOLD** Project and need a general overview without too much detail, we suggest that you read section 1 and choose some general references in section 3 for additional information.

We hope that you will find it an enjoyable and productive read!

Section 1:
The UNFOLD Project

1.1 THE UNFOLD PROJECT

David Griffiths
University Pompeu Fabra

For some years there has been a widely held opinion that the first generation of open eLearning specifications, while valuable, had limited eLearning to a relatively simple, single learner, 'deliver-and-test' approach, and are a step backwards if considered from a pedagogic perspective alone. A significant step forward was marked by the publication in January 2003 of the IMS Learning Design specification which enables flexible and sophisticated pedagogical approaches to eLearning, by providing support for:

- multiple as well as single learners and their coordination
- a wide range of present, as well as future, pedagogical models
- learning activities and learning services, as well as content.

When IMS publishes a specification a set of three documents are posted on their Web site, and the working group sits back for a well deserved rest, hoping that the rest of the world will pick up on their work and adopt the specification. Its fate may be to languish on a little visited web directory, or it may become universally adopted. Government agencies and influential commercial organisations, however, can and do promote specifications, and

the most notable example is the SCORM, which has received over 84 million dollars from the US Government in funding for awareness raising and implementation, plus mandated compliance in Federal funded projects.

In this context the **UNFOLD** project was conceived of as a measure to promote and coordinate the adoption, implementation and use of IMS Learning Design and related specifications, as this appeared to be the best candidate for resolving the need for more sophisticated interoperability. This judgement has been confirmed by developments over the past three years.

Funding was obtained from the Technology Enhanced Learning Programme and the project started in January 2004. Participation has been open to all those working with the specification or thinking doing so, or carrying out research in the area. The first six months of the project was devoted to awareness raising, compilation and development of resources related to the specification, and a particular effort to reach other projects in the Technology Enhanced Learning programme, and other Framework 6 initiatives.

Many different professional groups have to be involved if the IMS Learning Design specification is to be successful in providing better learning opportunities, but often these groups are not in contact with each other. Those developing specifications do not usually work with authors of

learning materials, and tools developers do not usually work with teachers and learners. If progress is to be made on these aims, then information needs to flow between these disparate groups of people. To meet this need the core activity of **UNFOLD** has been to support and facilitate Communities of Practice (CoPs) which are groupings of people who come together around common interests and expertise, creating, sharing, and applying knowledge within and across the boundaries of tasks, teams and organisations. The CoPs were launched in July 2004 with the establishment of three communities, for Systems Developers, Learning Designers and for Teachers and Learning Designers.

In practice the boundaries between CoPs has not always been completely clear, in part because the same people take up more than one role, but also because the development of basic tooling took longer than anticipated. Indeed it is only now, at the end of the project that a critical mass of Learning Designers is being established, and the first pilots with learners are being run. As a result much of the work done in **UNFOLD** involved groups of researchers working on various aspects of Learning Design, exchanging their results and insights.

1.2 LEARNING NETWORK FOR LEARNING DESIGN

Open University of The Netherlands

In addition to the **UNFOLD** project website, a second website is available at http://moodle.learningnetworks.org, under the title Learning Network for Learning Design (LN4LD) (see Figure 1). This was originally developed as the web for the Learning Designers CoP, as part of the Learning Networks programme being carried out at the Educational Technology Expertise Centre of Open University of The Netherlands (OUNL). It was seeded with five activity nodes looking for the attraction and stimulation of new users interested on IMS LD and trying to establish a operational base for potential users.

The use of this additional infrastructure enabled the project to leverage existing OUNL resources for the support of Learning Design, providing information, tutorials, worked examples of learning designs, and a growing repository of learning design units. The activities carried out on this web were very successful, and so all the forums and other interactive aspects of project work were focused on the site.

LN4LD is a pilot learning network for those interested in finding, applying and exchanging information about IMS LD. OUNL created LN4LD to gain early feedback on functional,

technical and organisational aspects of creating and maintaining a learning network and to help meet the demand for ongoing information on IMS Learning Design. Moreover, LN4LD is used to investigate mechanisms which stimulate learners to move beyond mere consumption of learning material towards active participation in the creation of learning experiences and to study the relationships between virtual activity and face-t o-face events.

There are two important concepts related to the description of LN4LD: a) a Learning Network (LN) is a distributed set of people who interact to create and share learning events while developing their competence in a particular discipline; and b) a learning event, which we refer to as an Activity Node (AN), can be anything that is available to support learning, such as a course, a workshop, a conference, a lesson, an internet learning resource, etc. All participants can create new ANs, can adapt existing ANs or can delete ANs, subject to the constraints of the policies which are operation for the learning network. Registered users having access to the **UNFOLD** forums and can post to and reply to the forums, cooperate on solving problems and answer questions concerning IMD Learning Design. Activity Nodes are dedicated to IMS LD topics (for example “IMS LD and metadata” or “IMS LD and SCORM”), and groups of interested

parties investigate issues in the area and develop learning activities and materials.

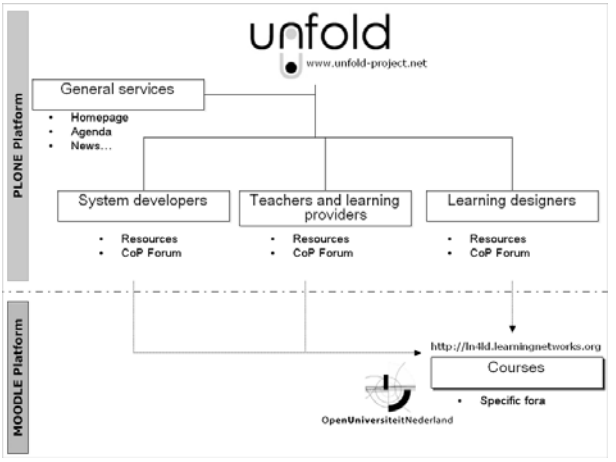

*Figure 1. Structure of **UNFOLD**'s websites*

1.3 HOW LEARNING DESIGN CAN BE USED

David Griffiths
University Pompeu Fabra

The learning objects movement has grown over the past few years, and is becoming increasingly mainstream. Several specifications and a standard for learning objects exist, and there is much interest in meta-data and content packaging. However, there is a growing feeling of uneasiness, a feeling that the primacy of re-usable learning objects is leading to e-learning limited to lone-learners reading from screens and being tested on their understanding. IMS LD is one aspect of a wider effort to produce richer alternatives which includes, for example, Moodle, LAMS, FLE3 and many more. This wider tendency is also sometimes known as “learning design” (without capital letters).

Like other developments informed by this perspective IMS LD starts from the position that learning is different from content consumption and that learning comes from being active. It recognises that learning does not necessarily have to involve formally defined learning objects, or, in some cases, documents of any sort. It recognises, too, that learning happens when learners cooperate to solve problems in social and work situations. In all this, it stresses that we must focus on the

learning in e-learning, and it is this focus which makes it important for educational developers. The Learning Design specification can be seen from (at least) four different perspectives, which connect with different communities of users and developers.

1) *An Educational Modelling Language*. IMS LD emerged from work done in Open University of the Netherlands (OUNL) (Koper and Tattersall 2005) when it was decided to move all its courses online, while maintaining the wide range of pedagogic approaches used. An attempt was made to create models of the key pedagogic approaches, but it soon became evident that this would be a never ending task, as the variety to be handled approached that of the number of courses taught. The solution was an Educational Modelling Language (OUNL-EML) with an XML binding which could be used to define a very wide range of pedagogic models (Koper, Hermans et al, 2000). This language was then adapted and adopted by IMS as the base for their Learning Design specification (IMS Global Learning 2003). Anyone who needs to produce a formal description of pedagogy will find IMS LD to be an essential reference point, and a potential solution. For example the Future Learning Environment 3 (FLE 3) uses IMS LD as its file format to represent its courses, while the ACETS project in the UK has used the specification as the basis for a structured

use cases of teachers use of electronic learning resources.

2) *An eLearning methodology*. A methodology has been developed to support the creation and use of Units of Learning, which is included in the IMS Learning Design Best Practice Guide (IMS Global Learning Inc 2003). In short, a Unit of Learning (UoL) is a regular lesson plan carried out in a Learning Design environment. In Chapter 2.2, a definition in depth of will be explained.

This methodology has emerged from practice in distance education using EML, and is particularly appropriate for institutions which have teams of technical experts who produce Units of Learning in collaboration with domain experts.

3) *A set of applications*. Since the publication of IMS LD there has been an initiative underway to produce tooling for the specification, which coordinated by the Valkenburg Group and by **UNFOLD**. Many applications have been developed, including Open Source initiatives such as the design time systems Reload Learning Design Editor, CopperAuthor and Collage, or the frely available ASK LDT, with **UNFOLD** playing a role in keeping all the development projects in touch with each other. The key runtime implementation is the CopperCore Learning Design Engine. This is a server application which handles all the underlying processing for running a Unit of Learning. The SLeD player makes use of

this engine and provides it as a Web service. A full list of applications is available in a later section of this document. These applications provide a valuable set of tools for any institution wishing to implement eLearning using the Learning Design specification, either because they want the functionality which is offered by the tools and methodology, or because they would like to make use of interoperable Units of Learning. The application set is not yet complete, and development of editors and players is continuing. Work is also underway on the connection between Learning Design and other specifications, and again **UNFOLD** has facilitated this process. Two key initiatives in this area are the eLearning Framework (ELF, funded by JISC in the UK) and the TENCompetence Integrated Project, which starts as **UNFOLD** finishes.

4) *An interoperability specification.* The mission of IMS is to create interoperability specifications for eLearning, and so, by definition, that is what IMS LD is. Its purpose is to enable applications to exchange UoLs, and to ensure that learners working on the same UoL using different applications on different platforms will be organised in the same way, and will participate in the same learning activities with the same resources. IMS LD does not constrain how eLearning applications should work, it only specifies an import and export format which they

must be able to work with if they want to be IMS LD compliant. Thus, at the risk of oversimplifying, a UoL can be seen as an interoperable lesson plan, and does not require the use of a particular methodology or infrastructure.

This is potentially much the most widespread use of IMS LD. It is vital for teachers who have invested a lot of time in creating learning activities using a Virtual Learning Environment, and who need to switch to another system. At present they can export the learning resources, but cannot, for example, take the learning activities defined in Moodle and open them in .LRN. If it is true that the specification can represent any pedagogic activity, then it should in principal be possible to enable any eLearning application to export its courses and activities as Units of Learning. Similarly the it should be possible for any eLearning application to provide IMS LD import (although in this case, of course, full import depends the importing application having all the functionality required to run an IMS LD Unit of Learning). It is very encouraging that it has already proved possible to create exports from the MOT+ plus tool (which predates IMS LD) and from the Dialog+ learning activity tool. At present work is underway to provide full or partial IMS LD import and export for Moodle, .LRN and LAMS, with interest being shown by a number of other systems. There is ongoing work to optimise interoperability,

and in particular to handle services which may not be the same on different systems (such as different forums, blogs, portfolios, etc).
It is worth noting that the Learning Design specification is divided into three parts, to make the task of implementation simpler. Level A provides the basic functionality to define roles, resources and activities; Level B adds properties and conditions which support sophisticated adaptivity and interactivity; Level C provides support for notification so that teachers, learners and other eLearning systems can be informed of progress in the learning activities. End users may that an awareness of these three levels may help in understanding documentation, but there is no reason why they should have to take them into consideration in their work.

1.4 TEACHERS AND LEARNING DESIGN

David Griffiths
University Pompeu Fabra

There are a vast number of documents and applications available on the web which can be used in teaching, both free of charge and for sale. Metadata (information about the documents) can be stored about the document, often consisting of a list of keywords hidden in the code of the document itself. If metadata has been included (and this is a big "if") then it becomes much easier to find useful documents. What metadata does not do, however, is give a teacher or parent any idea of what learning activities might be possible with the resources that have been found. This is where IMS Learning Design has a key role to play.

Using Learning Design a description can be created in XML which defines a Unit of Learning in terms of how *people* take up *roles* in order to carry out *activities* with *resources.* In this way it is possible to model the learning activities in a classroom or other educational context (but note that there is no aspiration to model the pedagogic principals which inform them, or the learning processes of the learners). Our work with Learning Design (and its predecessors) shows that it can specify a educational activities which draw on a very wide range of pedagogic approaches, ranging from, for example, discussion groups with no

content materials, to structured read and test approaches with no personal contact. Learning Design is the only open eLearning specification available which has this range of pedagogic expressivity and ability to work with groups of learners.

The resources referred to in the Units of Learning may be online resources, but can also be any other kind of document or object, and the Unit of Learning provides a pedagogic setting for the learning materials. Using this approach the same materials can be used in many different contexts (for example a reproduction of an old painting could be used to discuss history or aesthetics), and the same pedagogic approach can be used for different materials (for example an activity where learners divide into groups, discuss and report back to the full class can be used with all sorts of different materials).

Of course, teachers do not need Learning Design in order to carry out innovative activities with electronic learning resources, such as SCORM objects. What Learning Design adds is a notation for representing these activities and sharing them outside the teacher's immediate circle of practice. At the risk of oversimplifying, from the perspective of the teacher or educational institution Learning Design can be seen as an interoperable and standardised way of representing lesson plans, which enables learning activities to be defined to a

high level of detail and shared between teachers and learners. In Learning Design these plans are called “Units of Learning” (UoLs). They can be of any length, often much longer than a single lesson, but can be divided up into smaller sub units. Because the Unit of Learning is described in an explicit and standard way, it can be processed by a special application on a computer (known as a *player*), which can coordinate the UoL, making resources activities and services available to the right people at the appropriate time, keeping track of participants work, and controlling the flow of the learning activities. The same Unit of Learning could also be printed as a lesson plan, with a guide for the teacher and resources.

When the specification was first approved only programmers could make UoLs. Now tools are available which mean that anyone who is enthusiastic about working with computers can spend some time to get to know the specification and create Units of Learning, but this is still too demanding for most teachers, who have little time available. In the Teachers and Learning Providers CoP we have extensively discussed the ways in which teachers can participate in the development of UoLs, and the implications this has for systems developers and learning designers. This has contributed to the substantial progress has been made in the development of templates and interfaces which make it easier for teachers to

identify pedagogic scenarios, and to adapt Units of Learning. The ease of use of applications and pedagogic support for teachers is gradually improving, and we are confident that this trend will continue in the future. The ultimate goal is to enable users to focus purely on learning and teaching, perhaps being completely unaware that they are using Learning Design and other specifications.

It is only when appropriate tools are in place, and UoLs are available, that Learning Design can fulfil its purpose, and be used by teachers with learners. As **UNFOLD** draws to a close this is now starting to happen, and the results have been shared through the CoP. As this becomes more widespread in the coming months and years the activities supported by the CoP will become increasingly relevant.

1.5 LEARNING DESIGNERS AND LEARNING DESIGN

Daniel Burgos
Open University of The Netherlands

Learning designers who produce eLearning standards compliant designs, learning resources and activities obtain undoubted benefits in terms of interoperability and standard search criteria. This gain has, however, come at a cost, as they have found that their choice of pedagogy has been restricted. The standards available only support a single learner working in isolation, the role of the teacher is minimised, and the activities available are largely restricted to a relatively simple 'deliver-and-test' approach.

IMS Learning Design provides the opportunity to overcome these limitations. The specification is a modelling language which can be used to define and implement a wide (and in principal unlimited) range of pedagogies. Learners can work in groups, alone, and with teachers in activities which evolve over time.

If Learning Design is to line up to this promise of enabling better learning, a critical mass of useful and effective Units of Learning (UoLs) needs to be available to be used by teachers and learners. In achieving this the role of learning designers and authors of learning materials is clearly essential, but those interested in working with the

specification had no example UoLs to work from (apart from those in the specification documents), nor any way of learning essential skills. One of the key roles of the Learning Designers CoP has been to meet this need. A series of workshops has been organised at CoP meetings to raise the skills base, and online learning activities have also been provided, together with resources, including a collection of runnable and commented UoLs.

To inform the process of developing UoLs the CoP has facilitated links with the teachers and pedagogic experts who use the UoLs, clarifying the issues surrounding the nature of patterns and templates, and how they should be implemented.

Learning designers need authoring tools, and platforms for playing their designs, and the CoP has provided up to date information on available tools, and, perhaps more importantly, feedback to developers on the effectiveness of available applications, and outstanding user needs. This process has supported the production of multiple authoring tools, and multiple platforms capable of playing their designs, and so improve the outcomes which Learning Designers can achieve.

At present any learning designers using the specification needs knowledge of a number of fields, not only pedagogy but also software and programming languages, eLearning and technical requirements. Tools are mainly technically oriented and user-friendly interfaces focused on

teachers' needs are still under development. Nevertheless, this gap between teachers and tools will be closed before long with the next generation of tooling, and any person with a pedagogical background will be able to produce Units of Learning and become a learning designer.

1.6 SYSTEM DEVELOPERS AND LEARNING DESIGN

Chris Kew
University of Bolton

A specification such as Learning Design is simply a document, and without the contribution of systems developers it can be of no more than academic interest. This is true not only because the tools which they develop enable the specification to be used in practice, but also because development of reference implementations exposes possible ambiguities in the specification, and establishes accepted practice in interpreting it. The Valkenburg Group was established to coordinate this work for OUNL EML, and later this was extended to Learning Design. The **UNFOLD** Community of Practice (CoP) for System Developers has built on this work, so that developers can use effective implementations, and ensure consistency in developing and interpreting the specification. The CoPs meetings organised by **UNFOLD** have provided an opportunity for developers to demonstrate the evolving applications, and to keep their peers up to date on progress, representatives of almost all the applications mentioned in “Current State of Tooling” below have participated in **UNFOLD** meetings. As the tooling has matured it has been possible to test and demonstrate interoperability

between applications. Practical sessions working on mappings between Learning Design and the XML generated by applications have also proved valuable.

UNFOLD has also facilitated direct contacts between developers, both through forums and chat sessions, and in particular by eMail.

Although the CoP is by no means closed to proprietary developers, many of the development projects participating are Open Source. This has made it possible for a number of projects to build on existing applications, and particularly the two emerging Open Source reference implementations: the Reload Learning Design Editor and the CopperCore Learning Design Engine. For example SLeD and the Reload Player make use of the CopperCore engine, while Collage and theCo.De have made use of the Reload Learning Design Editor and its libraries.

The System Developer's Community of Practice helped to clarify a number of key issues through dialogue and subsequent publication in the Springer book "Learning Design: A Handbook on Modelling and Delivering Networked Education and Training" and the Journal of Interactive Media in Education (JIME). One area which is of particular interest at the time of writing is the integration of services, as the specification itself only has a limited number of services. This is closely related to ongoing discussions of the

architecture which specifies the roles of the applications which work with learning design. The collaboration between systems developers which has been established in **UNFOLD** has without doubt been productive, and looks set to continue for some time to come.

1.7 PHD RESEARCHERS AND LEARNING DESIGN

Davinia Hernández
Valladolid University

The IMS Learning Design specification reflects a change in emphasis away from using the computer to display educational content and towards using the computer to facilitate the teaching-learning processes. This change has been welcomed by educational technology researchers, who have also identified this as a priority in recent years. At present there is little doubt that IMS LD has provided challenging topics of research. IMS LD leads, for example, to unexplored problems in distributed systems, and in user interface design when applied to supporting coordinated flows of learning activities.

Since the release of IMS LD in February 2003 numerous interesting research lines have emerged, which have led to projects on a variety of scales, PhD thesis, etc. In some cases IMS LD is the focus of research, while others use the specification as an "instrument" to support or validate their proposals. These research lines combine a broad range of different keywords that might include but are not limited to: instructional design, educational modeling languages, pedagogical expressiveness, blended learning, collaborative learning, standards, interoperability, reusability, adaptation, ontologies,

taxonomies, patterns, templates, authoring tools, runtime engines, players, repositories, learning management systems, service-oriented computing, etc.

Moreover, not only does IMS LD present research challenges in many domains, but also itself relies on approaches and contributions from many disciplines. While the two main perspectives for successful implementation and use of IMS LD may be information and communication technologies and pedagogy, there are other disciplines such us sociology, psychology, artificial intelligence or human computer interaction that may also contribute to IMS LD. The relationship between IMS LD and these domains of study is a mutually beneficial one.

Research contributions to IMS LD range from development of tools to proposals regarding further improvement of the specification. These contributions, some of which represent the first implementations of IMS LD in practice, reveal the possibilitities and limitations of IMS LD. Perhaps even more importantly they provide multiple opportunities (conferences, workshops, project meetings, journals) for discussion, reflection and dissemination of the potential of IMS LD in changing the use of educational technology. These research driven activities have proved to be a key factor in making progress towards the adoption and extensive use of IMS LD in real practice.

1.8 UNFOLD COMMUNITIES OF PRACTICE ACTIVITIES

David Griffiths
University Pompeu Fabra

Over the course of the project **UNFOLD** has organised a large number of events, including

- 6 full **UNFOLD** CoP meetings
- 3 seminars in collaboration with other organisations
- 10 workshops
- 26 presentations, demonstrations, panel sessions, conference threads,

The more significant meetings are summarised below, and readers are directed to www.unfold-project.net for further details.

Soon after the launch of the project three evening seminars were run at a residential meeting in Schloss Dagstuhl, Germany, organised by the Valkenburg Group. This group is composed of organisations implementing Learning Design, many of whom had signed letters of support for **UNFOLD**. This was a valuable first opportunity to contact the user group, and receive feedback.

The project built on this first contact by preparing the web infrastructure and raising awareness of the **UNFOLD** among potential participants, and in July 2004 the CoPs were launched.

The six face to face meetings for the Communities of Practice were at the heart of project activities,

and each lasted three days (with the exception of the final Berlin two day event). These meetings have offered members the opportunity to have in-depth discussions with others working in similar areas, and they have proved to be the principal means whereby the Communities of Practice have become a reality. They have also offered practical sessions which have developed the skill base in creating Units of Learning, and have included break out sessions to work on particular topics. Attendance has ranged from forty to full houses of sixty or seventy, and participants have come from a wide spread of European countries, as well as from around the globe.

The themes addressed by the meetings have developed as time has gone by. When the first meeting was held in Barcelona in September of 2004 there were no tools for Learning Design available, and very few Units of Learning had been created other than those which were published as illustrations to the specification. The meeting focused on updating members on progress, and on planning for the most effective ways of working with the specification.

By the second meeting, in February 2005 in Valkenburg intensive work on tools development had come to fruition, and the meeting was the launch of the CopperCore Learning Design Engine, and the Reload Learning Design Editor Level A. There were workshops on creating Units

of Learning with level A, with input from Rob Koper and other members of the **UNFOLD** team. The following meeting in Barcelona in April built on this by offering workshops in Level B (which was by then supported by the RELOAD editor), again with in put from Rob Koper and the **UNFOLD** team. There were also workshops by three additional tools, COSMOS, ASK-LDT, and MOT+, together with a colloquium discussing the research agenda for Learning Design, and initial discussions on usability.

The fourth meeting, in Braga in June, focused on making it easier for non-experts to work with Learning Design, and a large number of projects working on various aspects of this issue presented their work, including Dialog+, LearningMapR, NetUniversité and LAMS. There were also presentations on pedagogy and policy from the Helen Beetham of JISC, and from Dominique Verpoorten on the 8 Learning Event Model. The series of workshops started in Valkenburg came to a conclusion with a Level C workshop, presented by Rob Koper and Daniel Burgos of OUNL. A particularly welcome development was the participation of Martin Dougiamas of Moodle, who took the opportunity to announce that Moodle would be moving towards compliance with Learning Design.

The fifth meeting, in Glasgow in October highlighted the strategic and architectural issues

involved in implementing Learning Design in an institution, with presentations from Bill Olivier (Technical Director of JISC), Scott Wilson of CETIS, James Dalziel of LAMS, and workshops on both the SLeD service based Learning Design player, and on the COLLAGE editor, which provides graphical templates enabling authors to create Units of Learning based on patterns, integrated with the Reload Learning Design Editor. One particularly exciting development was the first full pilot of Learning Design in a course, with Liverpool Hope University reporting on their use of SLeD.

The final CoP meeting in Berlin looked to the future, by mapping out the requirements for the next generation of Learning Design based systems, and to take the first steps to planning how this can be achieved. An architecture group reviewed existing architectures to determine how far they provide support for the required functionality, and a pedagogy group examined the possible vocabulary which could be used as the basis for dividing the functionality of the system into chunks which support teachers and learners in their use of the proposed system. The work was given focus by a presentation by Sue Bennett on the work of the Research Centre for Interactive Learning Environments, University of Wollongong, Australia, which has addressed precisely this problem. Other valuable input was

provided by Griff Richards of Simon Fraser University Canada, who provided an update on Canadian work on federated repositories of UoLs linked with federated networks of social software tools, and by Rachel Ellaway who described the work done in ACETS to use Learning Design to document teachers practice. Two other significant developments were reported: progress made in providing Learning Design interoperability for .LRN, and the announcement by Code AG, of one of the first commercial implementations of Learning Design to be released.

Three other multi-day seminars have been organised in collaboration with other organisations, each lasting two days. The first was in Paris in March 2005, organised together with ANFOR, and it was intended to raise the profile of the specification and the project in France. There proved to be substantial interest, and the initiative enabled the project to make contact with a number of new members and two implementation projects of which the community was previously unaware. The second additional meeting was the workshop at Heerlen, organised jointly with ProLearn, which provided a platform for members to share their research. Papers accepted for presentation at the workshop were published in the Special Issue on Learning Design of the IEEE journal Educational Technology & Society, and a number of presentations were also made from the JIME

special issue on Learning Design. Finally the project has collaborated in a seminar primarily intended for staff at the Universidad Complutense de Madrid, the largest in Spain, where the needs of end users can be addressed directly.

Online activities

This intensive programme of face to face activities was supported by online activities. These included an opt in mailing list with over 500 members, news postings on the project web site, and documents and links. Forums were provided for members to raise issues and problems relating to the specification, and some valuable discussions were held. It was however found that members much preferred to discuss these issues face to face at the CoP meetings. There were also online synchronous discussions on the **UNFOLD** server, and these proved very productive and popular. They were of two types. Firstly a number of discussions were held to enable members who had not been able to attend the events to participate in the debates and exchanges. Secondly discussions were held on position papers and other publications by **UNFOLD** members. Thus Bill Olivier discussed his paper on the state of Learning Design at the launch of the CoPs, David Griffiths discussed a paper on *The Role of Teachers in Authoring* Units of Learning, Griff Richards and Colin Knight

discussed their paper on *Learning Design and Representations of Instructional Intent*, members of the Moodle community and **UNFOLD** discussed their paper on interoperability of Learning Design and Moodle. The Springer Book on Learning Design was discussed with one of the Editors and some of the authors, and the JIME special issue on Learning Design was also the focus of a discussion. The participants in these discussions were very keen to exchange ideas and to pick up on news of research which was relevant to their work. This may be why the synchronous online exchanges were more effective than the forums, as they enabled participants to get feedback from a large number of participants almost instantly, in a brainstorm-like environment, whereas the same interactions in a forum would have taken weeks, and might never have reached critical mass.

UNFOLD has also produced a number of publications, which are available online from the **UNFOLD** web site. The project's Moodle server, Learning Networks for Learning Design, which hosts the **UNFOLD** forums, also provides learning activities for members, and a set of example Units of Learning with support for running them.

Funding for the **UNFOLD** project was up to the end of 2005, but there is every reason to suppose that the work will continue after the end of the project, if at a lower rhythm. The **UNFOLD** web

site and the opt-in mailing list will remain, as will the Learning Networks for Learning Design Moodle server with its forums and learning resources. Both these sites will be maintained by project partners. It is also anticipated that existing members and the new projects which are starting up as the **UNFOLD** project ends will want to make use of the mailing list to create events which enable them to contact the Learning Design user group, and to disseminate their results.

There is, however, a great deal to be done, and the project partners together with the wider membership will be looking for opportunities to apply for funding to ramp up their efforts now that the toolset for Learning Design is becoming more mature, and institutions are starting to use them with learners.

1.9 PARTICIPATION IN UNFOLD

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IMS LD has its origins in public education, and this remains the area in which it has greatest strength. Nevertheless, **UNFOLD** has throughout its activity made it a priority to reach the industrial sector. The project was launched to the industrial user group at the eLig (eLearning Industry Group) conference held jointly with EADTU (European Association of Distance Teaching Universities). The project has also maintained close contacts with PROLEARN, a network of excellence established explicitly to connect academic and industrial work in the area of eLearning. Developers of commercial applications have been invited to attend events wherever possible, and more than 50 commercial organisations have been represented at one or more events. This has included a number of companies developing LD applications, including Chronotech, eLive, Cosmos, GTK Press and the.Co.De. The majority of development efforts in the LD area are, however, Open Source. Many of these are funded by educational institutions or grants from education authorities. But there are a number of large number of independent Open Source organisations who are major players in the education market. These are typically non profit making industrial institutions, and a number of

these have also participated in **UNFOLD**, including LAMS, Moodle, Boddington and .LRN
The principal driver of the **UNFOLD** activities was a series of meetings and day seminar events. These provided the opportunity to gather valuable information, not only about the performance of the project, but also about the development of Learning Design. To these may be added ten workshops, principally addressed to people who were not already members of the Communities of Practice.
Questionnaires and interviews have shown that the level of satisfaction with meetings has been very high, with the organisation of the meetings being rated good or excellent by the participants. The meetings were seen to have provided interesting material and speakers, making them good forums where interaction could take place, and this result was consistent for all the meetings. In terms of supporting adoption of Learning Design initial results showed that 80% of a sample of 134 participants thought that **UNFOLD** opened up a wide range of opportunities, by providing hands-on information, supporting different types of communication and keeping practitioners up-to-date. Some specific weak issues were identified by participants at each meeting, which helped to improve subsequent events, but the strengths outnumbered the weaknesses at each meeting. A very high number of participants, 97% of total of

those interviewed, intended to participate in more meetings, which is a key indicator of success, and this renewed participation was been observed in the actual attendance.

The meetings also revealed a gradual increase in engagement with and use of Learning Design. This was in part conditioned by the appearance of tools in the second half of the project, which made it much easier for people to engage with the specification. As a consequence the activities focused largely on the development and use of authoring tools and player infrastructure, rather than the use of the specification with learners. The information gathered from participants leads us to estimate that the number of UoLs which have been produced with the specification went from near zero at the end of 2004 to a figure in the low hundreds a year later (leaving aside multiple versions of the same UoL with minor variations). As one would expect, this pattern is also reflected in use of the specification with learners, but with a delay from the availability of authoring and run-time tools. At first none of the participants had ever used Learning Design with learners, and this started to change in the final six months of the project, where some participants at all CoP meetings reported that they had done this.

This development in use of the specification is encouraging, and reflects the work carried out by **UNFOLD** in providing a platform for coordinating

development of tools, demonstrating them, and providing support in the creation of UoLs, and finally leading to the practical use of the specification which is the ultimate goal of the project.

Because many **UNFOLD** participants were only beginning to work with Learning Design their interests were very open ended, looking to make contacts, see tools, and gain skills. From this perspective it is perhaps unsurprising that the online activities which were most successful were synchronous text discussions, which enabled participants to gather varied information and perspectives, and learning activities which enabled participants to improve their level of skills. The forums provided were less used, perhaps because they are better suited to people searching for single answers to specific problems (e.g. detailed aspects of authoring techniques, or use of a particular UoL with learners), whereas a critical mass of participants with these needs had not yet formed. Given the self-selecting nature of the sample the results are not easy to generalise, and in many respects reflect the popularity of the meeting in terms of countries attending. **UNFOLD** CoPs' participants came from almost all European countries, from Australia, Candada, USA, South America and Africa. Thus interest in the specification is clearly widespread and awareness of **UNFOLD** is high, but this does not reflect a

wide impact on adoption in these countries (although they might provide an indication of the early adopters phase which occurs in the introduction of new products). The main impact, as expected, is in Europe, particularly in UK, The Netherlands, Spain and France, while on the world scale Canada and to a lesser degree Australia, were the key areas.

Feedback from participants indicates that the **UNFOLD** web sites, which play a key role in the project, seem to have fulfilled the needs of the community. This is confirmed by the logs analyses of the two sites (the main project web site and LN4LD site for forums and learning resources), where the following points are worth noting: (i) the search for IMS LD is increased in the second period, reflecting an overall impact of the specification; (ii) there has been a steady increase in activity in LN4LD related to basic materials, which indicates the increase in the impact of the specification and its use; (iii) there has been an increase of overall activity, indicating the success of the project in providing support, specifically through Activity Nodes, with good content; and (iv) the events supported this activity, which is strongly correlated with them (both before and after the meetings take place).

1.10 TEACHERS AND PATTERNS

Ana Días
Eucen

As mentioned above, the adoption of IMS LD in education and e-learning organizations depends largely on the speed of development of user friendly tools that can be used by learning managers, learning designers and teachers. Within the Learning Designers and Teachers CoPs one of the most discussed issues was related to the creation and use of templates and with the development of patterns that could reflect teachers' activity and *effective practice* in online courses, and so inform the development of tooling. The conceptual framework of IMS LD and the need to develop more usable tools for teachers both underline the usefulness of this deductive and inductive derivation of patterns from existing practice, providing LD with a collection of teachers´ practice that can guide designers when constructing UoLs.

The starting point for these discussion of this approach was Alexander´s definition of patterns «a pattern describes a problem which occurs over and over again in our environment and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over without ever doing it the same way twice» (Alexander, 1979). Other perspectives

see patterns as closely related to good practice: «Patterns are designed to capture best practice in a specific domain. Pedagogical patterns try to capture expert knowledge of the practice of teaching and learning.» (www.pedagogicalpatterns.org). «Design patterns in e-learning are descriptions of good practice in e-learning» (http://www2.tisip.no/E-LEN/). Whatever the perspective adopted, patterns are seen as models which describe solutions to recurring problems arising in various learning situations. The solutions themselves present successful techniques, derived either from pedagogical theory, research in psychology, educational sciences or from teachers practice. Learning patterns do not provide fixed rules for effective learning, they open the way to creativity among teachers, based on the practice of others. **UNFOLD** enabled a series of discussions on the issues raised by this approach, and this in turn led to examination of related aspects, in particular the development of mechanisms for helping teachers to identify the most effective templates for use in any given situation, and the design of repositories. It is clear that this approach depends on the capture of teacher's experiences, pedagogical models, pedagogical scenarios and practice in order to *map* them them into *Patterns* which can be turned into templates, and important work in this area was presented at CoP meetings.

Grounded work on templates and patterns by different research groups in Europe, Canada and Australia was shared and discussed in a number of CoP meetings, and is reported on the **UNFOLD** web sites and in Griffiths and Blat (2005a). Some of this work was closer to pedagogical theories and other closer to technological developments, and details are available in the annex, and on the **UNFOLD** web sites.

The **ACETS** project concentrated on using a natural language adaptation of the Learning Design specification to document teachers use of digital learning resources. **DialogPlus**, on the other hand, used a toolkit application to engage teachers in modelling pedagogic practice and identifying patterns. DialogPlus works with reusable "learning nuggets" at a lower level of granularity than a UoL, but which can be exported as Learning Design fragments. (www.dialogplus.org). The **LADIE** project is developing a reference model that supports Learning Activity Authoring (the design and construction of learning activities and the discovery, specification, sequencing and packaging of content) and Learning Activity Realization (the construction of the environment in which learning activities are to take place and execution of the learning activities themselves). The LADIE project is collecting use cases based on teachers´ practice, and making use of the work done by DialogPlus.

On the practical side, Collage is a tool that models different pedagogical practices of teachers in IMS LD. The work being carried out with the **LAMS** tool is also very relevant to this issue (see McAndrew et al, 2005). Collage also offers some guidance to users on the most appropriate choice of pattern, while **netUniversité** (Giacomini et al, 2005) and **LearningMapR** (Buzza et al, 2005) are currently developing more sophisticated systems for facilitating teachers choice of patterns.

Section 2:
The IMS Learning Design Specification

2.1 INTRODUCTION TO IMS LEARNING DESIGN

Rob Koper
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Introduction

Since the publication of the IMS Learning Design specification in February 2003 (IMS, 2003) various parties around the world have been active in developing tools, experimenting with Learning Design in practice, or doing 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 provide 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 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 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 publications highlights, 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 Learning Design I will briefly 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 was 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 2).

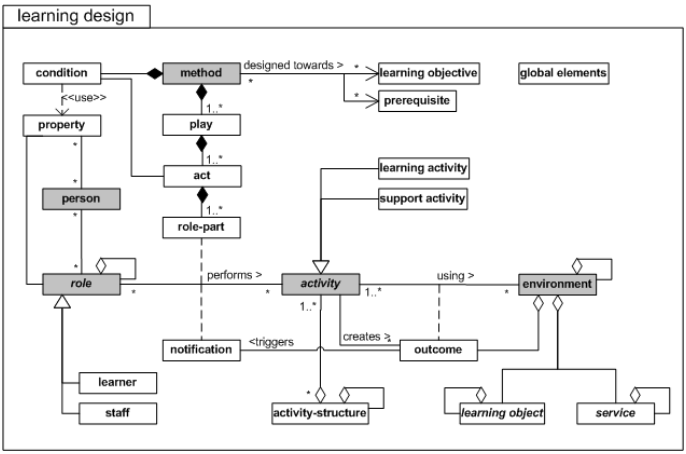

Figure 2. The conceptual model of IMS Learning Design

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 3) and XML DTDs. 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.

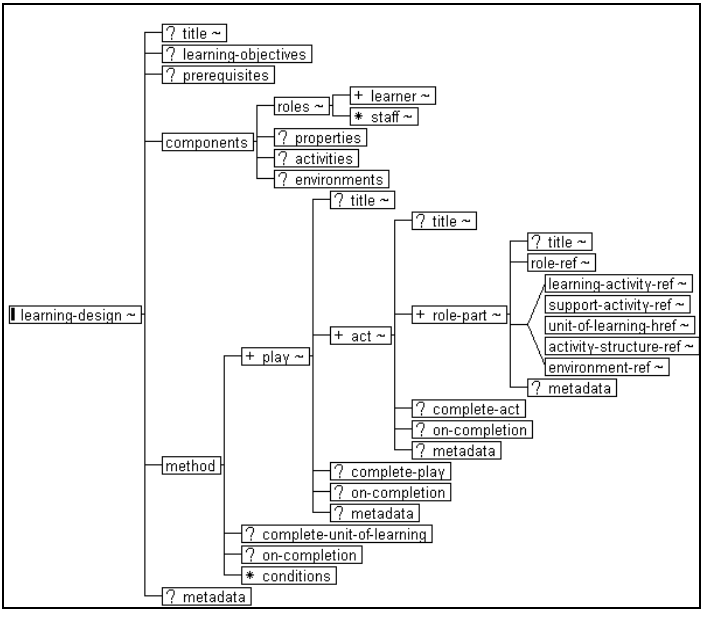

Figure 3. Part of the XML schema tree of IMS Learning Design

The result of all this 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 then manages the workflow ('activity management') by presenting all the actors with the appropriate activities and resources at the right time in the teaching-learning process.
For instance, consider the design of a Unit of Learning 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 participate in the first activity; this may 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 be prompted to carry out the support activity of providing feedback to the report. When the teacher has provided the feedback, the learners will be notified and receive learning activity 4. When activity 4 is completed, the teacher is notified that the report has been sent in for grading. The learners again will then be notified 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)
4. Demonstrators, usability improvement of tools, application profiles and conformance testing (2005/2006)
5. Actual use of Learning Design in practice and the development of a community of users (> 2006).

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, and some of the work is described in this booklet.
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 either 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) represent specific pedagogical approaches (learning design knowledge);
   d) 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 points 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 chapter, 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 present 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 urgently required 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.

2.2 IMS LEARNING DESIGN FROM INSIDE

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In 2003, the IMS Global Learning Consortium Inc. published the IMS Learning Design specification as a flexible way of representing and encoding learning scenarios for multiple and single learners. It may help to think of it as a way of creating interoperable lesson plans which can be read by an application called a *player*. The player can take on responsibility for coordinating the learners, teachers, learning resources and activities as the learning process goes forward (Burgos et al, 2005a).

According to the IMS Learning Design specification "*The core concept of the LD is that regardless of the pedagogical approach, a person gets a role in the teaching-learning process, typically a learner or a staff role. In this role he or she works toward certain outcomes by performing more or less structured learning and/or support activities within an environment"* (IMS, 2003).The particular characteristics of the roles which a person takes on, the activities to be carried out, and the particular characteristics of the environment define a specific learning scenario. This learning scenario can be represented in IMS Learning

Design, where it is called a Unit of Learning (UoL). The UoL can then be run on any Learning Design compliant system.

Learning Design does not offer a particular pedagogic model or models, but can rather be used to define a practically unlimited range of scenarios and pedagogic models. Because of this it is often referred to as a *pedagogic meta-model*. Some previous e-learning initiatives have claimed to be pedagogically neutral. Learning Design does not aim for pedagogic neutrality, but rather seeks to enable pedagogically aware e-learning.

Learning Design was developed in the context of e-learning, but there is no reason why Units of Learning cannot be used in mixed face-to-face and online learning contexts, or in entirely face-to-face learning.

IMS LD is the attempt to go beyond designing for lone online learners who are limited to reading from screens. Instead, IMS LD groups people, activities, resources, and flows, into scenarios to achieve learning objectives. The main issue is not to create content but to create structured learning activities designed to achieve the learning objectives.

Plays and acts

Learning Design uses a metaphor from the theatre to provide support in thinking about Units of Learning. A play is performed by a number of actors, who may take up a number of roles at different times in the play. Similarly in learning design a learner can take up different roles at different stages of a learning process. At the end of each act the action stops, all the learners are synchronised, and then a something new can begin.

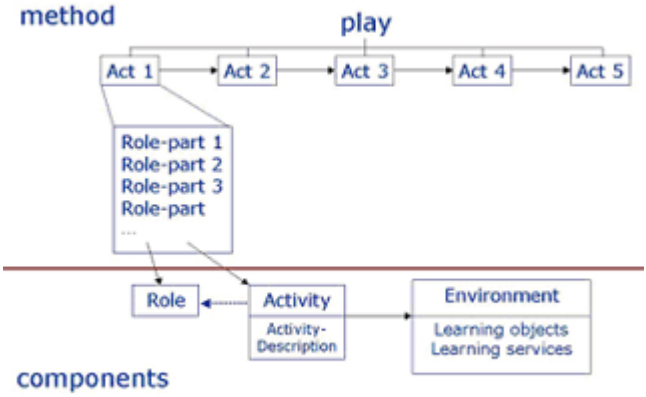

Figure 4. Diagram of a play (Olivier, 2004)

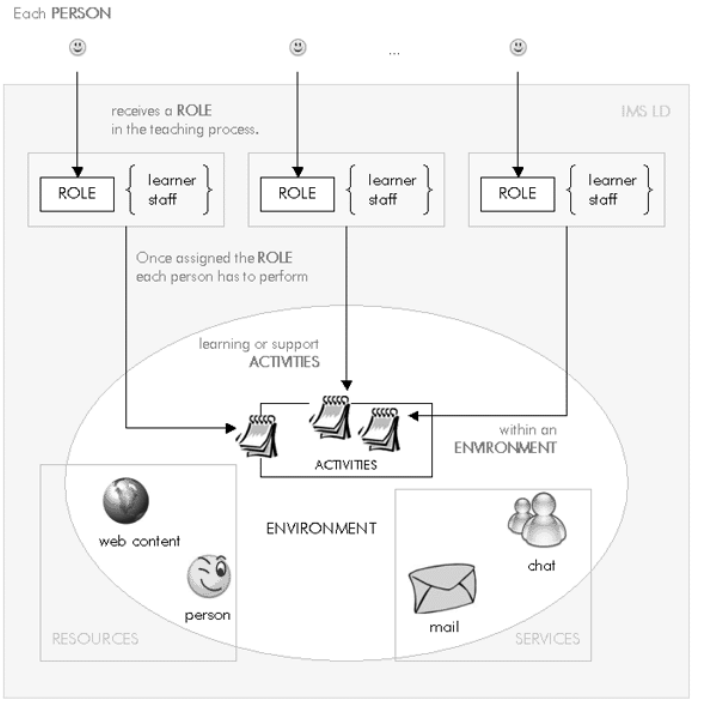

Figure 5. Diagram of an act

What is a Unit of Learning

Quoting Koper and Tattersall, 2005 "*A '*Unit of Learning*' refers to a complete, self-contained unit of education or training, such as a course, a module, a lesson, etc. The creation of a* Unit of Learning *involves the creation of a learning design*

and also the bundling of all its associated resources, either as files contained in the unit or as Web references, including assessments, learning materials and learning service configuration information".

Therefore, it is a ZIP file with:

- a XML manifest, describing method, plays, acts, roles, activities, environments, properties, conditions and/or notifications of the Learning Design specification. It also points to the related resources
- a set of files or resources mentioned in the XML manifest

IMS Content Packaging, another related specification, also builds packages with resources to be used under certain conditions, but without any method or pedagogy underneath. Therefore, the difference between IMS Learning Design and IMS Content Packaging is that IMS LD adds to IMS CP a full declaration under the Organizations label.

Furthermore, if we compare HTML contents with the structure written in an XML manifest of IMS LD, we notice that, besides the different mark-up language, there are other differences:

- An XML manifest is a single file that points to contents and resources, whereas an HTML file is a resource itself and can contain also references to other resources

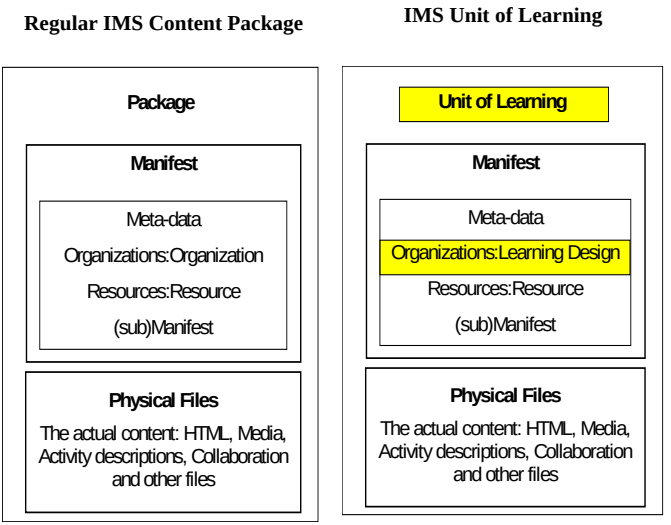

Figure 6. IMS Content Packaging vs. IMS Learning Design packages

- An XML manifest shows the skeleton and the method of an Unit of Learning, whereas an HTML website is just a set of linked and/or structured webpages
- An XML manifest can provide conditions, properties and notifications, that is, a kind of behaviour depending on user's actions, whereas an HTML website is a passive source of information

A comparison between a UoL in XML and the same information shown as an HTML website is at http://moodle.learningnetworks.org/mod/resource/view.php?id=160 and http://moodle.learningnetworks.org/mod/resource/view.php?id=174. Also, an extensive list of Example Units of Learning is available at http://moodle.learningnetworks.org/course/view.php?id=20

Where IMS LD comes from

The IMS Global Learning Consortium [www.imsglobal.org] which produced Learning Design was established in 1997. In the same year Open University of the Netherlands [OUNL, www.ou.nl] took the strategic decision to provide e-learning as key to their future development. Many pedagogies were already in use at the OUNL, and they needed to be supported. OUNL searched for a notation system able to describe a wide range of pedagogical models, which, once described, could be interpreted by a player able to read them the same way that a browser interprets HTML.
With this objective in mind, the OUNL developed the Educational Modelling Language (EML, 2000), a meta-language used to describe the learning process and supporting different approaches of learning.

EML involved the OUNL in three years of an internally funded R&D program, and three cycles of specification-implementation-refinement. The first version turned out to be too general, because it described many pedagogies but not enough detail. The second version was too specific, limited to a particular range of pedagogies. Finally, the third version was successful in describing a wide range of pedagogies with enough detail to be useful. EML v1.0 was made public in December 2000.
By the end of the 2000 IMS had developed specifications to describe learning content and objects (Metadata), to pass enrolments and return results (Enterprise), to transfer and display content (Content Packaging), to describe portable tests and return results (QTI), to describe learners and their learning (LIP).
IMS recognized, however, that there was the need to go beyond this, providing an specification to describe the learning process itself. It was an ambitious goal, with the need to support varying approaches to learning, supporting either multi-user or single learning while maintaining portability, searchability and reusability. Thus IMS needed a higher level design description, so work was started on the Learning Design (LD) Working Group (WG).
After working on the problem for some time the Working Group decided it would be more effective to adapt an existing specification than to build an

entirely new one. This led to a decision to adopt the OUNL's EML, which was accepted in 2001 as an input specification on which to build. The detailed structure of the EML changed substantially in its transformation to IMS LD but the core concepts remained the same.
IMS LD was approved as an IMS Final Specification on February 10, 2003. As a result EML is no longer maintained or updated, and OUNL's attention is now focused on IMS LD. Although EML and IMS LD share a common philosophy and aim, there are differences between the two.

How the specification is structured

Regarding the deliverables, the IMS LD specification consists of:

a) A conceptual model that defines the basic concepts and relations in a Learning Design.
b) An information model that describes the elements and attributes through which a Learning Design can be specified in a precise way.
c) A series of XML Schemas (XSD) in which the information model is implemented (the so-called 'binding').

d) A Best Practices and Implementation Guide (BPIG). An informative document explaining how to implement a development to accomplish the specification, providing background information and guidance
e) A binding document and example XML document instances that express a set of learning requirement scenarios.

Regarding the structure, IMS LD is divided into three implementation levels:

- **Level A**

  With roles, activities and environments. This is the core of the specification, containing the description of the elements that configure the IMS LD: people, activities, resources, the coordination between them through the method, plays, acts and roles. Using these elements time ordered learning activities can be defined. These are performed by learners and teachers, using learning objects, services and resources.

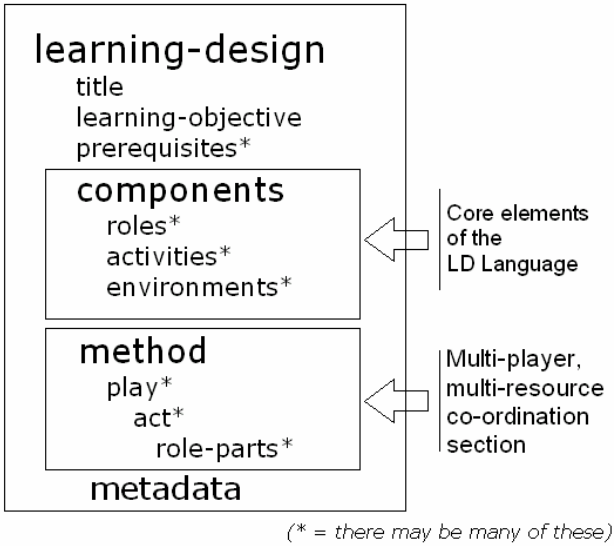

Figure 7. The Basic Structure of the Learning Design element

- **Level B**

  Adds properties, conditions, global elements and monitoring services to Level A, and gives learning designers the ability to define more complex structures. The properties store information about a person (preferences, results, etc), about a role or about a learning design. The state of the properties at any moment can determine the learning flow.

- **Level C**

  Adds notifications of new activities to Level B. These notifications are triggered automatically in response to events in the learning process. For example, if a student submits an assignment, the teacher will automatically be sent an e-mail with a notification.

2.3 CURRENT STATE OF TOOLING

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Specialised tools are considered necessary for the process of building and delivering UoLs, and these are expected to encourage wider adoption of the specification by virtue of their relative ease of use. There are three main types of tool needed to enable users to work with learning design including:

- Editors
- Runtime Players
- Repositories

CopperCore (Vogten and Martens, 2004) is the first engine capable of running Units of Learning. Other engines are under development, including NetUniversité (Giacomini et al, 2005), and .LRN (www.dotlrn.org).

Tools under development include both open source initiatives and proprietary systems, and some support all three levels of the specification while others are limited to supporting specific levels. The tools can be further categorized according to whether the intended end user will be working close to the specification at an in-depth and technical level (e.g. XML experts), or at a higher, non-technical level where the onus is on creating a Learning Design without the need for any specialised knowledge of the specification (e.g. Teachers etc.) In addition, there are a number of

tools available which are designed for tackling specific high or low level tasks as well as tools such as the CopperCore engine that are designed exclusively for developers. Also available are tools which provide added value to Learning Design by providing additional functionality to elaborate on the design process i.e. adaptation of existing learning flow patterns, learning activity taxonomies etc.
In order to guide newcomers through the potentially bewildering world of Learning Design and Learning Design related tools, the following sections aim to introduce and outline some examples of the different categories tools, without providing an exhaustive list of currently available products.

Learning Design editors

Without the use of specialised editors anyone intending to develop and/or edit a Unit of Learning (learning designers, course developers, etc) would have to hand code them in XML, however in the same way that HTML editors have facilitated the web design process, high level Learning Design editors allow users to author Units of Learning with similar ease. Conversely, low level editors afford technicians direct access to the code to help facilitate the process of document validation and to

complete a variety of tasks which would otherwise prove lengthy and circuitous.

Examples of high level editors currently released include:

Name	**Producer**	**Purpose**	**IMS LD Level**	**Ownership**
ASK-LDT Editor	EU project ICLASS: Informatics and Telematics Institute. (CERTH) Greece	Graphical editor.	A, B	Freeware
COLLAGE	University of Valladolid	High-level specialized Learning Design authoring tool for collaborative learning	A,B	Open Source
LAMS	LAMS Foundation	Learning Activity Management System with IMS LD Level A export	A ?	Open Source
MOT+	LICEF, Université de Quebec	General purpose graphical	A	Open Source

		editor, export to IMS LD		
Schul CMS	theCo.De	Specialised high level editor for Schools CMS	A	Proprietary

Examples of lower level general editors:

Name	**Producer**	**Purpose**	**IMS LD Level**	**Ownership**
aLFanet	aL.Fanet project	General purpose tree editor	A,B,C	Open source
Copper Author	Open University of the Netherlands	Tree based editor.	A,B,C	Open source
Reload Learning Design Editor	Reload Project (JISC)	General purpose tree based editor	A,B,C	Open Source

Runtime players

The complex interactions between the various roles, resources and activities that are coordinated into a workflow make implementation of a player complex. The CopperCore Learning Design

Engine provides the core functionality, and other developers can implement an interface on top. It also serves as a reference implementation, clarifying interpretation of the specification for developers, and giving authors a clear picture of how UoLs will behave at run time.
Examples of players currently include:

Name	**Producer**	**Purpose**	**IMS LD Level**	**Owner ship**
Coppercore Learning Design Engine	OUNL	Core of Learning Design player	A,B,C	Open source
RELOAD LD Player	RELOAD project	Viewer integrated with RELOAD LD Editor and built on Coppercore	A,B,C	Open Source
SLED Player	OU UK and OUNL	Service based LD player built on CopperCore	A,B,C	Open Source

As mentioned above, there are also related tools which are not full editors or players. For example, the DialogPlus Toolkit, developed as part of the DialogPlus project, documents pedagogic activities that can be exported as Learning Design fragments.

There are a number of development projects currently underway. These include two new players which will be integrated into NetUniversité (a new web based system for authoring and playing UoLs) and .LRN (a well established Open Source Virtual Learning Environment). The popular Moodle Virtual Learning Environment is working towards level A export in the near future, and full compliance within the scope of the current development roadmap. A number of editors are also under development. The range of tools identified above will no doubt expand as uptake and adoption of the specification grows.

In addition to changing the way people design for e-learning, the Learning Design specification also aims to support and promote reusability and sharing of resources and designs. To this end a repository is needed to store Units of Learning and their accompanying metadata which help users to locate them. Unlike the design and runtime aspects of Learning Design there is no need for specific tools to store UoLs but for best results repositories should be adapted to accommodate a number of IMS LD aware features including:

1) Improved search facility for:
    - Learning Design templates
    - Best practice examples in IMS LD
    - Learning Design content and pedagogy

2) IMS LD awareness so that the repository can search the elements of the UoLs
3) Information on learning resources including their use in previous designs
4) Metadata reports on the use of UoLs, success rating etc.

No such repositories have been developed to date, as the number of UoLs has not justified it. Work is now underway, however, which will fill this gap. The LionShare project has proposed Learning Design support within the its repository, a peer-to-peer, open source tool, and the Pool repository in Canada is also being adapted for this purpose.

Section 3:
Additional information

3.1 GLOSSARY

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Act
Part of a play. Roles are played by those taking part, for example learner, tutor, mentor, and so on.
http://www.cetis.ac.uk/lib/media/WhatIsLD_web.pdf

Activity structure
A container for activities and/or other activity-structures allowing sequencing and selection of its elements, and assigned to a role at a particular point in the learning process.
http://www.imsglobal.org/af/afv1p0/1523626

Collaborative Learning
Performing learning activities with two or more participants, including both asynchronous (e.g., discussion board) and synchronous (e.g., chat, video conferencing) systems. Standards based descriptions of collaboration require descriptions of the participants involved (and their different roles), the content involved, and the systems required to facilitate collaboration (cf. Learning Design WG).
http://www.imsglobal.org/af/afv1p0/1523626

Collaboration
A joint effort, facilitated by network technology with email, FTP (i.e., File Transfer Protocol used for downloading files on the Internet), and more advanced means of sharing ideas, documents, and data. http://www.trinity.edu/~rjensen/245glosf.htm

Community
A dynamic whole that emerges when a group of people share common practices, are interdependent, make decisions jointly, identify themselves with something larger than the sum of their individual relationships, and make a long term commitment to the well-being of their own, of others and of the group as a whole (Shaffer and Anundsen, 1993)

Community of practice
Group of practitioners in a certain field of expertise who share knowledge and experience. The group members typically possess different levels of experience and novices are supported to become expert members of the group through some guidance (or scaffolding) mechanisms (Lave and Wenger, 1991).

Components
The collection of parts that is reusable within a learning design. The elements role, activity-structure, learning-activity, support-activity and

environment are all included in the components section of an IMS Learning Design document instance.
http://www.imsglobal.org/af/afv1p0/1523626

Condition
A rule used to influence for flow of a play in a Unit of Learning. Used in conjunction with properties, conditions add further refinement and personalization facilities to a learning design. Conditions have the basic format:
IF [expression]
THEN [show, hide, or change something or notify someone].
The expressions are mostly defined on properties (e.g., IF pre-knowledge-English="4").
http://www.imsglobal.org/af/afv1p0/1523626

Design patterns
Design patterns provide a structure for integrating the analysis and solution of a problem, in a way that is sensitive to context and informed by theory and evidence. A pattern suggests, rather than prescribes, a solution (http://dspace.learningnetworks.org/bitstream/1820/300/2/e-len+design+patterns+booklet_final.pdf)

Dossier/Portfolio
Lifelong learners have specific expertise and competence in a discipline and these must be registered and updated in a learning dossier. The competence and expertise levels stored in the dossier must be standardized to be able to position a learner in an LN. http://dspace.learningnetworks.org/bitstream/1820/32/4/from-journal-LR_71-92.pdf

Educational Modelling Language
Semantic information model and binding, describing the content and process within a "unit of study" from a pedagogical perspective in order to support re-use and interoperability (Rawlings et al., 2002).

E-learning
Learning, in which computers and the Internet play an important role in the delivery, support, administration and assessment of learning (Kirschner and Paas, 2001).

Facilitators
In a Learning Network facilitators manage the operation of the network, they are for instance moderators and webmasters (Ferber, 1999; http://dspace.learningnetworks.org/bitstream/1820/66/2/framework-TDprogramme-internalUse.pdf).

Feedback-First order-Second order
-First-order feedback means that people in the community know what their counterparts are doing or have done regarding the UoLs in the network. This provides information for navigation and behavioral models within the community.
-Second order feedbackrefers to feedback about the emergent properties in the system: what is the performance of the community and how it is organized (Gilbert, 1995)

Global elements
A mechanism used in order to be able to set and view properties during the teaching and learning. There are four global elements: set-property, view-property, set-property-group and view-property-group. Global elements are designed to be included in any XML content schema by use of XML namespaces (e.g., for inclusion in XHTML). http://www.imsglobal.org/af/afv1p0/1523626

IMS Learning Design
Specification used to describe learning scenarios. It allows these scenarios to be presented to learners online, and enables them to be shared between systems. It can describe a wide variety of pedagogical models, or approaches to learning, including group work and collaborative learning. It does not define individual pedagogical models; instead it provides a high level language, or meta-

model, that can describe many different models. The language describes how people perform activities using resources (including materials and services), and how these three things are coordinated into a learning flow (http://www.cetis.ac.uk/lib/media/WhatIsLD_web.pdf

Learning activity
An activity to be carried out by a learner in order to obtain a learning objective. The notion of a Learning Activity recognizes that learning can happen with or without learning objects (learning is different from content consumption) and that learning comes from learners being active. http://www.imsglobal.org/af/afv1p0/1523626

Learning community
(a) has distributed control,
(b) shows commitment to the generation and sharing of new knowledge, (c) learning activities are flexible and negotiated,
(d) community members are autonomous,
(e) shows a high level of dialogue, interaction and collaboration, and (f) there is a shared goal, problem or project that brings common focus and incentives to work
together.
http://carbon.cudenver.edu/~bwilson/dlc.html

Learning Design (IMS LD)
IMS LD enables the representation of the learning and teaching processes in a UoL to be interoperable and machine interpretable. It provides a framework for including learning activities, support activities, assessment and learning or knowledge resources. IMS LD can express the pedagogical approach taken in the UoL, and supports personalization of learning routes and reusability (Koper & Van Es, 2004). http://dspace.learningnetworks.org/bitstream/1820/32/4/from-journal-LR_71-92.pdf

Learning design method
Determines which roles get which type of activity at a given time, based on a pedagogical approach. http://dspace.learningnetworks.org/bitstream/1820/32/4/from-journal-LR_71-92.pdf

Learning environment
A social system focused on the permanent development and certification of human knowledge and competencies in a particular domain.
http://dspace.learningnetworks.org/bitstream/1820/38/2/koper-inaugural-address-eng.pdf

Learning object
Any entity, digital or non-digital, that can be used, reused or referenced during technology-supported learning

Learning objectives
The intended outcome for learners. It is possible to define learning objectives both at the global level of the Unit of Learning and for every single learning activity in the learning design. http://www.imsglobal.org/af/afv1p0/1523626

Learning scenario
Learning design which contains play, act, and role-parts elements (analogous to a theatrical play). http://www.cetis.ac.uk/lib/media/WhatIsLD_web.pdf

Learning Technologies
Means of formalizing pedagogical and organizational thinking in such a way that it can be implemented in a technical domain. That is, they bridge the gap in e-learning between educational, organizational, and technical requirements (Jochems, van Merriënboer, and Koper, 2004).

Levels of implementation within learning design
Level A, with the definition of the method, plays, acts, roles, role-parts, learning activities, support activities and environments. It is the core of the

specification, contains the description of the elements that configure IMS LD and the coordination between them. For instance, role-parts define what activities must be taken by a role in order to complete an act and, subsequently, a play.

Level B adds properties, conditions, monitoring services and global elements to Level A, and provides specific means to create more complex structures and learning experiences. Properties can be used as variables, local or global ones, storing and retrieving information for a single user, a group or even for all the characters involved. Through these mechanisms the learning flow can changed at the run time, as decisions can be made taking into account dynamic content.

Level C offers the opportunity for more sophisticated learning designs through notifications (messaging), which allow for notification of new activities to be triggered automatically in response to events in the learning process. It enables the automation of learning flow activities, which are triggered by the completion of tasks, rather than the learning flows being pre-planned. For instance, a teacher may be notified by email that an assignment has been submitted and needs marking; once the score has been posted, the learner may be

notified to undertake a new activity according to the result.
http://www.cetis.ac.uk/lib/media/WhatIsLD_web.pdf

Monitoring service
The monitor service provides a facility for users to look at their own properties or that of others in a structured way. A monitor uses global properties in resources of type 'imsldcontent' to view the properties of one-self or of all users in a role.
http://www.imsglobal.org/

Notification
The triggering of new activity or the sending of a message in response to an event. Events which trigger notifications include the completion of an activity and the changing of a property-value.
http://www.imsglobal.org/af/afv1p0/1523626

Pedagogical model
-Prescribes an effective teaching/learning process for a class of learners to achieve a class of learning objectives in a class of situations
-The most effective learning products or environments are those that are problem-centred and involve the student in four distinct phases of learning:
(1) activation of prior experience,
(2) demonstration of skill,

(3) application of skill and
(4) integration of these skills into real-world activities'. He further summarizes the underlying 'first principles of instruction' by stating that learning is promoted when: learners are engaged in solving real world problems; existing knowledge is activated as the foundation for new knowledge; new knowledge is demonstrated to the learner; new knowledge is applied by the learner; and new knowledge is integrated into the learner's world. (Merrill, 2003)

Play
A play specifies which roles perform what activities in what order. A play is modelled according to a theatrical play with acts and role-parts. In general: a play consists of a sequence of acts. In each act, different activities are set for different roles and are preformed in parallel. When an act is completed, the next act starts until the completion requirements for the learning design are met.
http://www.imsglobal.org/af/afv1p0/1523626

Property
A variable used for a variety of purposes including monitoring, personalization and assessment. Learning Design supports five types of properties: local properties, local-personal properties, local-

role properties, global-personal properties and global properties.
http://www.imsglobal.org/af/afv1p0/1523626

Providers
Can be educational institutions, companies and libraries that provide lifelong learners (e.g. employees), the learning services (e.g. tutoring services) or the learning resources (e.g. books, CDs).
http://dspace.learningnetworks.org/bitstream/1820/32/4/from-journal-LR_71-92.pdf

Support activity
An activity carried out in support of a role performing one or more learning activities. For example, a staff role might have the support activity to grade reports made by people in the learner role named 'student'. Each student creates his/her own report and the tutor grades every report (repeating the 'grade report' support activity).
http://www.imsglobal.org/af/afv1p0/1523626

Unit of Learning (UoL)

Complete piece of educative work created following a learning design structure and packaging the related resources, web links and several learning material and services in only one ZIP file. Therefore, it is a compressed file with a) a

XML manifest, describing method, plays, acts, roles, activities, environments, properties, conditions and/or notifications of the Learning Design specification and also pointing to the related resources; and b) a set of files or resources mentioned in the XML manifest."

Run of Unit of Learning
Instantiation for a specific set of learners in a certain time frame (e.g., a class, the actual run of a workshop).
http://dspace.learningnetworks.org/bitstream/1820/32/4/from-journal-LR_71-92.pdf

Usability
An LN is usable when it supports rapid learning, high skill retention, low error rates and high productivity. It is consistent, controllable and predictable, making it pleasant and effective to use (Preece, 2000).

Use cases
Abstractions of scenarios in which the concrete behaviour of persons within a system, or using a system is described

3.2 LINKS AND RESOURCES

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IMS–LD

- IMS Consortium
http://www.imsglobal.org/
- IMS Learning Design Specification
http://www.imsglobal.org/learningdesign/index.html
- **UNFOLD** Project
http://www.unfold-project.net
- Learning Networks
http://www.learningnetworks.org
- Learning Network for Learning Design
http://moodle.learningnetworks.org/
- Runnable Example Units of Learning
http://moodle.learningnetworks.org/course/view.php?id=20
- Learning Networks Dspace
http://dspace.learningnetworks.org/index.jsp
- The Valkenburg Group
http://www.valkenburggroup.org/valkenburggroup-org.htm
- R2R: Learning Design
http://commons.ucalgary.ca/weblogs/learningdesign/

Tools

Editors
- Alfanet LD
http://dspace.learningnetworks.org/handle/1820/103
- COLLAGE

http://ulises.tel.uva.es/collage/
- Copperauthor
http://www.copperauthor.org/
- eLive
http://www.elive-ld.com/content/index_ger.html
- Eduplone Learning Sequencer
http://eduplone.net/index_html?cl=en
- MOTPlus
http://www.licef.teluq.uquebec.ca/gp/eng/productions/mot.htm
- RELOAD
http://www.reload.ac.uk/
- SchulCMS
http://www.schulcms.de

Players
- CopperCore Learning Design Engine
http://www.coppercore.org/
- RELOAD
http://www.reload.ac.uk/
- SLED
http://sled.open.ac.uk/web/

Virtual Learning Environments
- LAMS Learning Activity Management System (Level A export)
http://www.lamsinternational.com/
- .LRN (full LD compliance under development)
http://www.dotlrn.org/
- Moodle
(LD export-import under development)
http://moodle.org/
- NetUniversité (under development)

http://www.cepiah-hds.utc.fr:8080/CEPIAH/web/index.jsp

Others

- ACETS

Investigation of the pedagogical use of reusable learning objects

http://www.acets.ac.uk/

- ALFANET

Set of components for learning providers using personalization and adaptation

http://rtd.softwareag.es/alfanet/

- CASLO

Environment for collaboration in development of learning objects

http://caslo.dei.inf.uc3m.es/

- DialogPlus

Helps teachers to define learning activities through a taxonomy with LD export

http://www.dialogplus.org/

- ELF (ELearning Framework)

Common approach to Service Oriented Architectures for education

http://www.elframework.org/

- LearningMapR

Pedagogical design tool using LD templates

http://lt3.uwaterloo.ca/innovation/ldrg.html

Institutions

- Centre for Educational Technology Interoperability Standards (CETIS)

http://www.cetis.ac.uk

- Information Society Technologies
  http://www.cordis.lu/ist/

Other IMS Specifications

- IMS Content Packaging
http://www.imsglobal.org/content/packaging/index.html
- IMS Learner Information Packaging
http://www.imsglobal.org/profiles/index.html
- IMS Question and Test Interoperability
http://www.imsglobal.org/question/index.html
- IMS Simple Sequencing
http://www.imsglobal.org/simplesequencing/index.html

Related specifications

- Dublin Core Metadata Initiative
http://dublincore.org
- Advanced Distributed Learning. SCORM
  http://www.adlnet.org/index.cfm?fuseaction=scormabt
- About SCORM
http://www.rhassociates.com/scorm.htm

3.3 BIBLIOGRAPHY

Aspin, D. N., and Chapman, J. D. (2000). Lifelong learning: Concepts and conceptions. *International Journal of Lifelong Education*, 19(1), 2 – 19.

Burgos, D., Berbegal, N., Griffiths, D., Tattersall, C. and Koper, R. (2005) IMS Learning Design: How the specifications can change the current e-learning landscape. *E-learning World*, issue 2, March-April. 2005. Moscow, Russia: Magazine of Moscow State University for Economy, Statistics and Computer Science

Burgos, D., Tattersall, C., Koper, R. (2005) *Utilización de estándares en el aprendizaje virtual. Funcionalidades didácticas de la especificación IMS Learning Design*. II Jornadas Campus Virtual. Madrid: Universidad Complutense

Buzza, D., Richards, L., Bean, D., Harrigan, K., Carey, T. (2005). LearningMapR: A Prototype Tool for Creating IMS LD Compliant Units of Learning. Journal of Interactive Media in Education (Advances in Learning Design. Special Issue, eds. Colin Tattersall, Rob Koper), 2005/17. ISSN:1365-893X [jime.open.ac.uk/2005/17].

Cetis (2005) CETIS website and CETIS encyclopedia. United Kingdom: CETIS. Available at www.cetis.ac.uk. Retrieved on April 28th, 2005

CP (2004). IMS Content Packaging v1.1.4 Final Specification, retrieved January 15, 2004 from http://www.imsglobal.org/content/packaging.

Dalziel, J. (2003). Implementing Learning Design: The Learning Activity Management System (LAMS). Retrieved July 16, 2005 from http://www.lamsinternational.com/documents/ASCILITE2003.Dalziel.Final.pdf.

Ferber, J. (1999). *Multi-agent Systems.* Reading: Addison-Wesley.

Field, J. (2001). Lifelong education. International Journal of Lifelong Education, 20(1/2), 3 – 15.

Fischer, G., and Ostwald, J. (2002). Transcending the information given: Designing learning environments for informed participation. Paper presented at the Proceedings of ICCE 2002 International Conference on Computers in Education, Auckland, New Zealand.

Giacomini, E., Trigano, P., Sorin, A. (2005). A QTI editor integrated into the netUniversité web portal using IMS LD. Journal of Interactive Media in Education (Advances in Learning Design. Special Issue, eds. Colin Tattersall, Rob Koper), 2005/09. ISSN:1365-893X [jime.open.ac.uk/2005/09].

Gilbert, N. (1995). Emergence in social simulation. In N. Gilbert and R. Conte (Eds.), Autonomoussocieties: The computer simulation of social life, pp. 144 – 156. London: UCL Press.

Griffin, C. (1999). Lifelong learning and social democracy. International Journal of Lifelong Education, 18(5), 329 – 342.

Griffiths, D., Blat, J. (2005a). The Role of Teachers in Editing and Authoring Units of Learning using IMS

Learing Design. International Journal on Advanced Technology for Learning, 2(3).

Griffiths, D., Blat, J., García, R., Vogten, H. and Kwong, KL. (2005 b). Learning Design tools. In Koper, R. and Tattersall, C. (Eds.) Learning Design, a Handbook on Modelling and Delivering Networked Education and Training, Heidelberg: Springer-Verlag, 109-135.

IMS (2001) *Content Packaging*. Boston: USA. Available at www.imsglobal.org. Retrieved on August 15th, 2005

IMS (2001a) *Learner Information Package*. Boston: USA. Available at www.imsglobal.org. Retrieved on July 30th, 2005

IMS (2003) *Learning Design*. Boston: USA. Available at www.imsglobal.org. Retrieved on July 30th, 2005

IMS (2003a) *Simple Sequencing*. Boston: USA. Available at www.imsglobal.org. Retrieved on July 30th, 2005

IMS (2003b) *Question and Test Interoperability*. Boston: USA. Available at www.imsglobal.org. Retrieved on July 29th, 2005Koper, R., Tattersall, C. (2005) *Learning Design: A Handbook on Modelling and Delivering Networked Education and Training*. Germany: Springer Verlag

Jennings, N. R. (1998). A roadmap of agent research and development. Autonomous Agents and Multi-agent Systems, 1(1), 7 – 38.

Jochems, W., van Merriënboer, J. J. G., and Koper, R. (2004). *Integrated e-Learning: Implications for pedagogy, technology, and organization.* London: RoutledgeFalmer.

Karampiperis, P. and Sampson, D. (2005). Designing learning services for open learning systems utilizing Learning Design. In Uskov, V. (Ed.) Proceedings of the 4th IASTED International Conference on Web-based Education, Grindelwald, Switzerland: ACTA Press, 279-284.

Kirschner, P. A., and Paas, F. (2001). Web-enhanced higher education: A Tower of Babel. *Computers in Human Behavior, 17,* 347-353.

Koper, E.J.R., and Manderveld, J. M. (2004). Educational modelling language: modelling reusable, interoperable, rich and personalised Units of Learning. British Journal of Educational Technology, 35 (5), 537-552

Koper, E.J.R., and Tattersall, C. (Eds.) (2005). Learning Design: A handbook on Modelling and Delivering Networked Education and Training. Heidelberg: Springer.

Koper, R. and Olivier, B. (2004). Representing the Learning Design of Units of Learning. Educational Technology and Society, 7 (3), 97-111.

Koper, R. (2004). IMS Learning Design: What it is and Update on Current Activities. Retrieved 19 October 2005 from http://hdl.handle.net/1820/276.

Lave, J. and Wenger, E. (1991). *Situated learning: legitimate peripheral*

participation(Cambridge,Cambridge University Press).

LD (2003). IMS Learning Design. Information Model, Best Practice and Implementation Guide. Version 1.0 Final Specification IMS Global Learning Consortium Inc. Retrieved May 26, 2004 from http://www.imsglobal.org/content/learningdesign/.

LICEF (2004) *MOT+*. Canada. Available at www.licef.teluq.uquebec.ca/gp/eng/productions/mot.htm. Retrieved on May 25th, 2005

OUNL (2004). *Learning Network for Learning Design*. Heerlen: Open University of The Netherlands, OTEC. Available at http://moodle.learningnetworks.org. Retrieved on August 14th, 2005

LORNET (2004). Portals and Services for Knowledge Management and Learning on the semantic web. Project of the Natural Sciences and Engineering Research Council of Canada (NSERC) and Industry of Canada. http://www.lornet.org.

Martens, H. and Vogten, H. (2005). A Reference Implementation of a Learning Design Engine. In

McAndrew, P., Goodyear, P., Dalziel, J. (2005). "Patterns, designs and activities: unifying descriptions of learning structures". Available at http://www.lamsinternational.com/CD/html/resources.html, retrieved 4th December 2005.

Merrill, M. D. (2002). First principles of instruction. "Educational Technology Research and Development," 50 (3), 43-59.

OUNL (2000). *Educational Modelling Language, EML*. Heerlen: Open University of The Netherlands. Available at http://dspace.learningnetworks.org/handle/1820/81. Retrieved on August 3rd, 2005

OUNL (2002) *Dspace repository*. Heerlen: OpenUniversiteitNederland. Available at http://dspace.learningnetworks.org. Retrieved on August 31st, 2005

Paquette, G., Léonard, M., Ludgren-Cayrol, K., Mihaila, S. and Gareau, D. (2005). Learning Design based on Graphical Modelling. Educational Technology and Society

Preece, J. (2000). Online communities: Designing usability, supporting sociability. Chichester: Wiley, pp. 26-27

PROLEARN (2004). Network of Excellence Professional Learning. EU 6th Framework Project.

Rawlings, A., van Rosmalen, P., Koper, R., Rodrigues-Artacho, M., and Lefrere, P. (2002). *Survey of educational modelling languages*, Learning technologies workshop, CEN/ISSS Workshop on Learning Technology, Brussels.

Reload (2005). Reusable eLearning Object Authoring and Delivery Project, retrieved on July 25, 2005 from http://www.reload.ac.uk/.

Shaffer, C. and Anundsen, K. (1993) *Creating community anywhere* (New York, Perigee Books).

Tattersall, C. and Koper, R. (2004) *EML and IMS Learning Design: from LO to LA*. Heerlen: OUNL. Available at http://dspace.learningnetworks.org. Retrieved on June 23rd, 2005

TELCERT (2004). Technology Enhanced Learning Certification - European Requirements and Testing. EU 6th Framework project. http://www.cordis.lu/ist/telearn/fp6_telcert.htm.

TENCompetence (2005). Building the European Network for Lifelong Competence Development. EU 6th Framework Project (December 2005-December 2009). www.tencompetence.org.

UNFOLD (2004) *UNFOLD Project*. Retrieved August 30th 2005 [http://www.unfold-project.net]

University of Bolton (2005) *Reload Project.* United Kingdom: JISC Project. Available at www.reload.ac.uk. Retrieved on April 22nd, 2005

Van der Vegt, W. (2005) *CopperAuthor*. Heerlen: Open University of The Netherlands. Retrieved at www.coppercore.org . Retrieved on July 29th, 2005

Van Rosmalen, P., Vogten, H., Van Es, R., Passier, H., Poelmans, P. and Koper, R. (2005). Authoring a full life cycle model in standards-based, adaptive e-learning. Educational Technology and Society, this issue.

Vogten, H. and Verhooren, M. (2002). IMS Learning Design UML Models. retrieved on 19 October, 2005 from http://hdl.handle.net/1820/214.

Vogten, H., Martens, H. (2005) *CopperCore 2.2.4*. Heerlen: Open University of The Netherlands. Retrieved at www.coppercore.org . Retrieved on August 9th, 2005

EPILOGUE

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Three years ago IMS Learning Design was invisible, just about to emerge from the working group which was preparing the specification, and only of interest to a few specialists in educational modelling languages. Since then we have been working in **UNFOLD** to increase awareness of the specification and to promote implementation and adoption. As you can see from this publication, as a community we have had many successes, and much to be proud of. Our goal now should be different: we need to make the specification less visible and less widely discussed!

In the first stages of adoption of we needed to persuade people that IMS Learning Design was an effective solution, but now that applications are becoming available the task is rather different. Rather than debating the merits of Leaning Design as a modelling language we need to be demonstrating the effectiveness of Units of Learning. Rather than persuading developers we expect that user groups will require interoperable learning activities. Rather than discussing the merits of the specification, we aspire to providing teachers with tools and methodologies which enable them to work at the level of pedagogy, without thinking about the IMS Learning Design

specification. Of course, there will still be a need for specialists to work directly with the specification, but the aspiration which has informed the work of **UNFOLD** is that most teachers, learners, authors and administrators will be able to use systems without being aware of the specification, just as they publish Web pages without understanding Web servers, or knowing how to write HTML.

This goal is visible in the distance, and while there is still some way to travel a number of key lines of work will bring it closer. Firstly, the usability of tools for non experts needs to be improved, so that authors can develop and manipulate Units of Learning without being aware of the technical implications. Secondly, users should also be able to work with a variety of specifications without knowing which they are using. Solid progress has been made in this by integrating IMS LD and IMS QTI, but this needs to be continued and extended to the other specifications in the IMS family and beyond. Thirdly, the integration of IMS LD into a service based architecture needs to be further developed, and from another angle, work is underway to enable Units of Learning to call on a wider range of services, and to set them up automatically. Both these lines of development will be essential in a world where web services are becoming ever more important. Finally, at the level of pedagogy, the availability of reusable learning

activities is raising many issues of how to divide up learning activities, how to share them, and how to describe and evaluate them, which will become more pressing as more teaching is carried out using IMS LD.

None of these lines of development presents insuperable difficulties, but together they represent a demanding programme of work which will keep the communities involved in **UNFOLD** busy in the coming years.