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From the Editors …

Welcome to the July 2011 issue of the Learning Technology newsletter on Adopting Standards and Specifications for Educational Content.

This issue is edited by Guest Editor Prof. Rifon - Project Leader of the CEN Learning Technologies Standards Observatory - and includes articles from some key experts and projects at a European level. We sincerely hope that the issue will help in keeping you abreast of the current research and developments in R&D in standards and specifications. We also would like to take the opportunity to invite you to contribute your own work on technology enhanced learning (e.g. work in progress, project reports, dissertation abstracts, case studies, and event announcements) in this newsletter, if you are involved in research and/or implementation of any aspect of advanced learning technologies. For more details, please refer to the author guidelines at http://www.ieeetclt.org/content/authors-guidelines.

Special theme of the next issue: **Virtual Worlds for Academic, Organizational, and Life-Long Learning**

Deadline for submission of articles: **September 20, 2011**

Articles that are not in the area of the special theme are most welcome as well and will be published in the regular article section.

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Preface from the Guest Editor

This special issue of the IEEE Learning Technology newsletter is focused on the domain of Standards and Specifications for Learning Technologies. It gathers eight articles on different topics within the standardization area, all of them by European experts in this field.

The first three papers describe some current trends towards the developments of new standardization products in Europe. The first article authored by the chair and vice-chair of the CEN Workshop for Learning Technologies presents a proposal for a domain model for standards that is under consideration by this pre-standardization group. The following two articles present the main outcomes from two recently finished European projects: ASPECT and iCOPER. Both project coordinators describe the main outcomes of these initiatives finished in 2010 with an overall funding over 8,000,000 €.

The authors of the remaining papers provide their vision on five key standardization fields. Content aggregation and transfer is discussed through two different approaches: SCORM and Common Cartridge. The new ISO standard for content metadata is introduced providing an initial comparison with the de-facto standard, the IEEE LOM, from the perspective of the authors. Existing proposals dealing with accessibility and internationalization are presented in the following two papers altogether with the identification of still missing gaps. Finally, the authors of the last article of this special issue describe their experience with one of the key proposals in the area of Educational Modeling Languages, the IMS Learning Design specification.

I would like to thank the authors of these top quality papers for their valuable contribution to this special issue. I hope they will provide a better insight of the current situation of the learning standardization process from a European perspective.

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Special Theme Section: Adopting Standards and Specifications for Educational Content
Modelling the CEN WS-LT Standardisation space

Introduction

How can we describe the learning technology domain as a guideline for standards development, how can we identify current and future needs for standardization? This is the key question of this article and the key question for stakeholders in standardization bodies.

The emergent and sometimes disruptive qualities of the learning technology domain makes it a challenge for Standard Setting Organisations to be sure they have the most relevant projects on their agenda. Within such a heterogeneous domain there are few well resourced stakeholders with a clear vision of what they need to harmonise in order to develop the market.

The goal of pre-standardization (in our case the CEN Workshop Learning Technologies) is to bridge the gap between R&D projects and formal standardization. It is the main goal to identify mature approaches, specifications, and guidelines and develop and prepare those for formal standards. However, there is still an access barrier for stakeholders to enter the – sometimes complex and time-consuming – standardization process.

In the CEN Workshop on Learning Technologies (CEN WSLT) the need for a proactive approach to standard-building has been felt for some time. Besides the access barriers, there is competition also between standardisation bodies, and doing the right thing in a timely manner is more and more critical. New work items can be created at any time based on the needs of stakeholders to deliver output (the main instrument is the CWA, CEN Workshop Agreement). As an example, the development of the Metadata for Learning Opportunities set of specifications was guided by some principles drafted in Athens October 2007 (the “Athens Declaration”), stating “harmonisation efforts should focus on small, simple models based upon existing commonalities that can be expanded upon at national or regional level, rather than all-inclusive monolithic standards”.

However, these efforts need to fit the overall vision and big picture. Thus, the WS-LT has embarked upon a domain map modeling exercise in order to provide a useful instrument in strategic planning of new activities reacting to current and future market needs.

Why model, – how, and with what tool

Standardization bodies develop in many cases isolated specifications which in some cases might even include the development of competing specifications. We see a domain model as the key to coherent standards’ building: Small models fit into a bigger picture. When this bigger picture is not managed within a single project, e.g., within MLO-AD, the first project of what has become known as the European Learner Mobility (ELM) specifications, there is a need for overview and coordination. The ELM group members used conceptual modeling. The maps were openly shared, using a Cmap server put up by a European project (http://icoper.org:8080). This modeling practice have then been extended to the strategic work of the WS-LT as a whole.
The CEN WS-LT Domain Model

The WS-LT standardization landscape model (Figure 1) is part of the business plan for the CEN workshop. The current version consists of two parts, a diagram of process clusters and a representation of standardization activities and the WS-LT’s relation to these activities.

The model needs explanation and could easily be criticized for being inconsistent and incomplete. However, the value of this model is the fact that it needs to be explored and explained in a conversation including at least some experts that have helped developing it. As such it is a never ending invitation to ask the key strategic question the business plan should answer: Where do we have the “white spots” on our map in need of new work items?

Figure 1 - CEN Workshop on Learning Technologies Domain Model, June 2011
What do the models tell?

The “transitional” and dynamic qualities of conceptual models give a key to understanding their role in pre-standardization. The models do not represent the truth or objective reality. On the contrary, they represent a vehicle for establishing some points of view on the reality – a view that has to be defended, argued and further developed during every encounter of the experts taking part in the conversation. The maps are wide open to interpretations, even if color keys are provided and definitions are popping up when you hover over a concept. Therefore, they cannot stand alone as the final word about how the workshop understands the domain but provide a vehicle for discourse and consensus building. As a consequence, ownership to these models play an important role and will influence how they are received in the community. In the development process of a specification the models often play an important role in the beginning when the central concepts are explored. In the final document, the models tend to end up in an annex, if they are included at all. Where the individual expert’s interests lie, in the conceptual clarification of the scope or in the technical serialization of the concepts, may influence the individual’s enthusiasm for and involvement in the modeling. Of course, a number of other factors also play a role. It is observed that experts have different approaches to how specification work should be done, as some experts prefer a tabular representation of the artifacts in discussion; others prefer some kind of visualization, e.g., conceptual models.

It can be stated that conceptual modeling facilitates discussions and discourse in the domain – for pre-standardization; this is a key to success to build coherent standards and include stakeholders by incorporating their ideas, understandings and interests.

Conclusion

Conceptual modeling is a new and dynamic concept in standards development aiming at creating coherent standards and increasing common understanding of the domain. We have shown the current status in the CEN WSLT. This status reflects the current work – most important, however, is the contribution of concept models towards the discussion in the community. Thus, we would like to invite the readers to actively comment on the processes and specifications for future agenda setting.

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ASPECT: Learning Specifications at Work

Introduction

The ASPECT Best Practice Network, supported by the European Commission’s eContentplus program, started in September 2008 and involved twenty-two partners from fifteen countries, including nine Ministries of Education, four commercial content developers and leading technology providers. For the first time, experts from all international standardization bodies and consortia active in e-learning (CEN/ISSS, IEEE, ISO, IMS, ADL) worked together to improve the adoption of learning technology standards.

In the course of thirty-two months, the ASPECT consortium implemented and tested two categories of specifications: specifications for content use (e.g., content packaging); and specifications for content discovery (e.g., metadata, vocabularies). Through this work, the project identified best practices for learning content discovery and use and produced recommendations for the education community in Europe.

Work in developing these best practices involved project partners and teachers using the European Schoolnet1 Learning Resource Exchange2 (LRE) service that enables educators to find open educational content from many different countries and providers. An important focus in the project was the exploration of specifications for content packaging (SCORM and Common Cartridge). During ASPECT, content providers from both the public and private sectors applied content standards to their learning resources and made them available via the LRE. As a result of this activity, learning resources became available in multiple formats. For example, SIVECO, one of the commercial content providers involved in the project decided to make their learning resources available as both SCORM and Common Cartridge packages. This immediately raised the very practical issues of knowing how to describe such resources and how to present them to end-users.

Representing Packaged Content

A first problem comes from the fact that metadata specifications generally used for describing digital learning resources such as Dublin Core (DC) and IEEE Learning Object Metadata (LOM) are not very good at describing packaged content. LOM, for example, makes a distinction between:

1. Technical format: e.g., an educational resource is a flash animation and
2. Educational learning resource type: e.g., an educational resource is an assessment.

But LOM does not provide a dedicated mechanism to express that a flash animation is packaged, for example, as a SCORM package. As a result, to describe packaging information, it is necessary to profile LOM either by mixing packaging information with format or learning resource type or by adding a dedicated element. None of these solutions is fully satisfactory.

Furthermore, metadata specifications usually do not allow for describing more than one manifestation of a learning resource in a metadata record. For instance, it would be necessary to describe a learning resource packaged as SCORM in an individual metadata record and the

1 http://www.europeanschoolnet.org/.
2 http://lreforschools.eun.org/.
same resource packaged as Common Cartridge would require another metadata record. As a consequence, references between these two metadata records must be established for expressing the fact that they describe two different manifestations of the same resource. In practice, such references between metadata records are extremely difficult to manage and process, especially when, as is the case with the LRE, metadata records are exchanged within a federation of multiple repositories and portals.

To overcome this problem, ASPECT has collaborated with the IMS Global Learning Consortium to propose IMS Information for Learning Object eXchange (ILOX)\(^3\). ILOX is part of the IMS Learning Object Discovery & Exchange (LODE) specification\(^4\). ILOX is not a new metadata specification but rather a framework for organizing existing metadata specifications necessary to fully describe digital objects and handling them as a whole. For example, ASPECT has developed an LRE Metadata Application Profile\(^5\) that combines ILOX with LOM to describe a learning resource, its different versions and the different formats in which these versions are available. Note that, since ILOX is a framework for organizing metadata rather than a new metadata specification, it was possible to automate the generation of ILOXes from existing LOM records, thus easing the adoption of the new profile by the LRE content providers.

**Presenting Content to End-Users**

Having solved the problem of describing learning content available in multiple versions and formats, the next challenge was to design a way to present this information to the LRE’s end users.

The solution adopted consists of only letting end users interact with abstract views of learning resources. These abstract views hide the information about the different versions and formats in which the corresponding resources are available. This hidden information is only made available when a user selects an individual resource and when the context in which the user operates is not sufficient to automatically select an appropriate copy of the resource.

The screenshot of Figure 1 shows an LRE search results set. Each thumbnail corresponds to a learning resource matching the search criteria (in this example, resources about physics in Romanian).

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\(^3\) For an introduction to ILOX see [http://dlib.org/dlib/november10/massart/11massart.html](http://dlib.org/dlib/november10/massart/11massart.html).

\(^4\) [http://imsglobal.org/lode/](http://imsglobal.org/lode/).

The screenshot of Figure 2 shows the more detailed description of a learning resource obtained by clicking on the thumbnail of this resource in the results set. Here again, only an abstract view on the resource is provided. At this abstract level that the user is invited to interact with the resource by adding it to a list of user’s favorite resources, rating/commenting the resource, sending the resource description to a friend, or reporting a problem.
Figure 2 - Resource Details

Figure 3 demonstrates how selecting between manifestations is required only when users initiate the ‘get resource’ feature. In this example, the resource is available as a SCORM package, as a Common Cartridge package (both can be either rendered by a player associated with the portal or downloaded) and as a web object.

Figure 3 - Obtaining a Resource
Conclusion

The concept of manifestation\(^6\) of a learning resource has now been broadened from original function of dealing with content packaging. Manifestation as a concept is now used to help users distinguish between other kinds of manifestations such as landing pages, previews, or the thumbnails themselves. As the LRE for Schools portal evolves the power of the IMS LODE ILOX framework has consistently permitted us to more easily develop better services for end-users.

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\(^6\) This concept comes from FRBR (see [http://www.ifla.org/en/publications/functional-requirements-for-bibliographic-records](http://www.ifla.org/en/publications/functional-requirements-for-bibliographic-records)) on which ILOX is based.
The **ICOPER Reference Model for Outcome-based Higher Education**

The eContent+ Best Practice Network, ICOPER, aimed at contributing to a more effective and efficient implementation of technology-enhanced learning in higher education with a particular emphasize on outcome-oriented teaching and interoperability based on standards and specifications. With March 2011 the project released its core report, the ICOPER Reference Model (IRM) for Outcome-based Higher Education.

The report provides a common frame of reference for stakeholders who wish to contribute to the design and development of outcome-oriented teaching and content for re-use. Driven by this objective the IRM is designed to improve interoperability of educational systems and applications both at the processes level, as well as at the technical level (i.e. data and services).

The IRM is constructed on the basis of the work of ICOPER’s work packages 1 to 6. Each of these work packages addressed a different area within higher education. The created knowledge is condensed to

- a domain model of competence-driven higher education that puts the concept of “shareable educational resource” in the center of all thinking;
- a data model explicating the key concepts of the domain model, associations and attributes. Here an emphasize has been put on providing data models for artifacts such as Personal Achievement Profiles, Learning Outcomes, Learning Opportunities, Instructional Models, Learning Content, and Assessment Resources; and
- a service-oriented architecture connecting repositories of sharable educational resources based on web services.

The proposed data and service models were based on existing standards and specifications as far as these standard and specifications were able to support our requirement of providing interoperability of technologies relevant for outcome-based higher education. The standards and specifications investigated included the following:

- ADL SCORM
- CEN MLO
- CEN SPI
- CEN SQI
- HR-XML Competency
- ICOPER PALO
- IEEE LOM
- IEEE LOM
- IEEE RCD
- IMS CP
- IMS LD
- IMS QTI
- JISC LEAP2A
- ISO/IEC 19796-1
- ISO/IEC 19796-3
- OAI PMH
Further, the IRM provides a process model for top-level process areas such as:

- Learning Needs Analysis and Learning Opportunity Definition
- Instructional Modeling
- Content Development for Re-use
- Assessment, and
- Evaluation.

The implementation of the data and service models including the processes connecting the various artifacts are demonstrated in the following 14 ICOPER applications. These applications range for extensions of open source learning content management systems (e.g. DotLRN, Moodle) and commercial products (e.g. Clix, LearnExact), modifications to existing brokerage infrastructures for content, to software-as-a-service solutions (e.g. 2know2.com). Installations of e-portfolio tools were also subject of our implementation work like operational learning management infrastructures in universities (e.g. Learn@WU). To illustrate the power of e-learning standards we devoted one implementation case study to a full authoring round trip, where a commercial authoring tool was extended in order to support content re-use via the brokerage infrastructure Open ICOPER Content Space (OICS).

The ICOPER web site was also connected to the OICS. At the time of this writing the website herewith provided access to 83,824 shareable educational resources with over 20,000 hours of typical learning time. The following types of shareable educational resources are provided via the OICS (in brackets number of resources currently provided):

- Instructional Models (34188)
  - Assessment Methods (2)
  - Assessment Designs (1778)
  - Learning Designs (26628)
  - Teaching Methods (5780)

- Learning Content incl. Assessment Resources (45549)
  - Learning Content (45368)
  - Assessment Resources (181)

- Learning Outcome Definitions (3304)
- Learning Opportunities - Total (783)
  - Learning Opportunity Instances (481)
  - Learning Opportunity Specifications (302)

Based on the evaluation of the ICOPER applications we came up with recommendations for

1. higher education management when it comes to implementing outcome-oriented learning,
2. faculty members when it comes to preparing courses or developing content for re-use,
3. implementers of all kinds-of tools ranging from full fledge brokerage infrastructures over learning management systems to content authoring tools,
4. standardization bodies when it comes to enhancing state-of-the-art from an outcome-oriented perspective.

From these recommendations it can be concluded that introducing learning outcomes has certainly the potential to improve higher education in Europe, for example, by improving the
transparency of learning opportunities, but also for supporting quality management. However, a significant number of challenges on

1. the technical (e.g. extending e-learning standards as proposed by the IRM),
2. the individual (e.g. qualifying educators writing learning outcomes), and
3. the organizational level (e.g. introducing curricular design processes based on learning outcomes)

remain in order to make outcome-based education keeping up with its promises.

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Common Cartridge is not SCORM!

The Common Cartridge specification explains in detail the structure of a common cartridge and the conditions for conformance with the specification. An extensive set of frequently asked questions on the IMS web site also compares Common Cartridge with SCORM. In particular it explains that Common Cartridge targets a usage different from that of SCORM: While SCORM mainly addresses computer based training, where a learner is learning on her own interacting with a computer, Common Cartridge addresses blended learning scenarios where a teacher (or a community) plans a course.

The most common use of SCORM is distributing content packages. The fact that Common Cartridge provides this functionality as well, however, often hides the important differences in the way the teacher and learner interact with each of these package types. This note intends to highlight these differences from a user’s point of view.

The user acquires a SCORM package, imports it into a learning management system (LMS) and the learner(s) access it as one single block of content. All interaction with the SCORM package is done through the LMS’s SCORM interface as defined in the SCORM specification. In this way, the SCORM package remains exterior to the LMS, very much as any external web site a teacher may point his students to, though with the important additional feature that the SCORM package may report back to the teacher information on the learner’s progress.

In contrast, when a Common Cartridge is imported into an LMS, the cartridge is completely ingested and resolved. Just the pure cartridge structure remains, allowing navigation through the imported content. Assessments in the cartridge are re-located to the assessment store of the LMS and the cartridge’s forums become indistinguishable from other forums that may have been defined within the LMS. Any cartridge resource becomes an ordinary content object of the LMS. There is no way in which the user can interact with the cartridge after import as it ceased to exist in the LMS.

This explains, why the Common Cartridge specification does not specify a runtime interface as SCORM did. More precisely, the most recent version 1.1 of the Common Cartridge specification, however, has added a runtime interface using the Basic LTI specification – but it did not do this at the level of the cartridge, but at the level of individual resources so that it can be applied even after the cartridge has been resolved.

Once imported, a learner could browse the content of a cartridge in very much the same way as she can browse an imported SCORM package or a purchased text book. However in a blended learning scenario, the teacher may want to adapt the content to the particular context of his course. He will include only the parts the students need to read and he will link it to other content that he is using. If the LMS permits, the teacher will selectively release content items to students. He may even want to alter content, for example to adapt the scoring of a test item to the standards used in his faculty. With SCORM all these changes would be the privilege of the author. Thus Common Cartridge transfers many of the author’s privileges –

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7 This work was supported by the ASPECT project. ASPECT is a Best Practice Network co-funded by the European Commission under contract ECP 417008. The author is a member of the IMS Global Learning Technical Advisory Board. All views expressed in this document are solely that of the author. They do not express any view of the European Commission or of IMS Global Learning.

8 http://www.imsglobal.org/cc/ccfaqs.html
and pedagogic responsibilities – to the teacher. Interviews with teachers, done in the European project ASPECT, show that this is highly appreciated by them.

Most current LMS already provide the teacher with tools to render web content, to discuss topics in forums and to select questions from a question bank for building tests. Therefore all that is required to make full use of Common Cartridges is an import function which puts the content of a cartridge into the appropriate places where these items are stored internally and to aid the teacher in finding them, making use of the organization element that comes with the cartridge.

The Common Cartridge specification intentionally avoids specifying anything which LMSs are good at. Its sole purpose is the delivery of content as raw material for building complex interactive course experience with whatever tool is appropriate. It is assumed that teachers and instructional designers will use the tools they are used to, in particular the LMS, to add such features like sequencing or tests. It is also perfectly in line with the intention of Common Cartridge to mix cartridge content with specialized content that utilizes particular strengths of the particular LMS in order to deliver a learning experience that is better than can be obtained by just providing a cartridge in a player.

The difference in purpose between SCORM and Common Cartridge becomes particularly clear when we consider their potential use in connection with the IMS Learning Design (LD) specification. A learning design will consider a SCORM module as one resource. It will reference it in the design at the appropriate place and an LD player will have to call a SCORM player with this SCORM module at runtime when reaching this place in the design. Hence, in case of SCORM, all interaction with the SCORM module will happen at runtime.

While this is possible as well with a Common Cartridge, it is not its main intended usage. In order to enable the instructional designer to build better courses with a Common Cartridge, the LD editor must provide him/her with access to the individual items of the cartridge so that he/she can select them for inclusion into the course design. Once selected, they must be used to configure the required resources, for example a discussion forum for a particular discussion topic for use in the LD player. At runtime the LD player will use these resources. Hence in case of Common Cartridge the primary interaction with the cartridge will not be at runtime but at the time when the course is designed.

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E-learning Metadata Standards

Nowadays, the most commonly used standard for learning object metadata is IEEE LOM. The ISO organization is in the process of developing a new standard for educational resources metadata: ISO/IEC MLR. This article looks at different aspects and approaches of these two standards.

From 2003, the "ISO/IEC JTC1/SC36 Information Technology for Learning, Education and Training" sub-committee, has been developing the multipart standard “ISO/IEC 19788 Metadata Learning Resource (MLR)” with the goal of specifying metadata elements and their attributes for the description of learning resources; this includes the rules governing the identification of metadata elements and the specification of their attributes. MLR is based primarily on existing standards “ISO/IEC 15836:2009 The Dublin Core Metadata Element Set” [1] and “IEEE 1484.12 Learning Object Metadata (LOM)” [2]. The first part of this standard has been published in 2011 [3], and the other parts are under preparation.

Among metadata standards that can be applied to learning objects [4], IEEE LOM has proven to be a leader in the cataloging, classification, search, and retrieval of learning objects. The emergence of ISO/IEC MLR opens new possibilities in the capabilities of metadata records for learning objects. This new standard is based on two basic principles:

- Modularity: The standard is structured in several parts, which allow to group different data elements of the metadata according to their nature, facilitating further growth of the standard with new parts.
- Compatibility: It opts for compatibility with LOM and Dublin Core.

The first version of MLR is structured modularly into six parts [3], at the expense of being extended thereafter. The general structure of the metadata record of MLR is defined in Part 1 of the standard, called Framework [3]. It identifies and specifies the attributes of a metadata element as well as the rules governing their use. Part 3 of the standard is dedicated to show a basic application profile, applied to the data elements from Dublin Core, which serves as an example of use of the standard. The four remaining parts of MLR are called: Dublin Core elements (Part 2), Technical elements (Part 4), Educational elements (Part 5) and Availability, distribution and intellectual property elements (Part 6). These four parts are dedicated to identify and define data elements to register metadata educational resources, while LOM defines nine categories to classify the data items.

Compatibility with Dublin Core is provided by the two standards: LOM includes a short and functional annex to indicate the relationship of its data elements with Dublin Core; and MLR devotes a whole new set of standard data elements that redefines and extends the Dublin Core elements.

It is essential that metadata can give support to include general information about the educational resource such as title, description, language, keywords, etc. LOM dedicates the "General” category. MLR mainly uses the redefined Dublin Core elements included in Part 2.

It could be regarded that one of the most relevant information, from the point of view of the usefulness of an educational resource metadata, corresponds to data stored about pedagogical features of the educational resource. Table 1 shows the number of data elements that both
standards offer to register educational information. As it can be seen, in general, MLR overall incorporates 45% more of this information.

<table>
<thead>
<tr>
<th></th>
<th>ISO/IEC MLR</th>
<th>IEEE LOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational information</td>
<td>16</td>
<td>11</td>
</tr>
<tr>
<td>Intellectual Property</td>
<td>25</td>
<td>3</td>
</tr>
</tbody>
</table>

*Table 1 - Number of data elements included.*

Table 1 also shows that MLR offers much more capacity to include information about intellectual property. MLR devotes a part of the standard to define criteria relating to intellectual property, including information on resource availability, intellectual property and patents in force so that the creator of new educational resources has easily accessible the change and use restrictions, in order to work with them legally. In contrast, LOM offers little opportunity to include information on intellectual property.

Table 2 compares these two standards based on some characteristics that identify differences and similarities between them.

<table>
<thead>
<tr>
<th></th>
<th>ISO/IEC MLR</th>
<th>IEEE LOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of parts or categories specifying data elements</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Possibility to define obligatoriness in data elements</td>
<td>Yes (presence indicator)</td>
<td>No</td>
</tr>
<tr>
<td>Modular</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Expandable</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Adaptable</td>
<td>Yes (user extensions)</td>
<td>Yes (application profiles)</td>
</tr>
<tr>
<td>Dublin Core compatibility</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Taxonomic path</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Meta-metadata</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Table 2. Comparing MLR and LOM.*

Probably the standard MLR will be expanded before its delivery in such a way as to include new features such as taxonomic path.

The wide expanse of LOM in coverage and categories of data elements could become an added difficulty to the process of completing the metadata information of an educational resource. Besides, the elements included in MLR are defined with a greater focus to the user to facilitate the tasks of search and retrieval of learning objects.

Given that the usefulness of the metadata of educational resources is contingent upon the completeness of the information fulfilled in the metadata, it is interesting the possibility in
MLR of marking certain items as compulsory, whereas in LOM all data elements are optional.

The increased modularity and user focus makes it possible to think in MLR as a reference standard for learning objects metadata.

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Standards and specifications to manage accessibility issues in e-learning

Despite the acknowledged need of providing a personalized and adaptive learning process for all, current learning management systems do not properly cover personalization and accessibility issues and they are still struggling to support the reusability requirements coming from the pervasive usage of standards. There is a lack of frameworks for providing layered-based infrastructure covering the interoperability required to manage the whole range of standards, applications and services needed to meet accessibility and adaptations needs of lifelong learning services.

In the context of the A2UN@ project [1], we have analyzed the existing specifications and standards aimed to cover accessibility issues that can support the description of accessible and adaptive learning scenarios. For this analysis, we have considered as key sources of information the report on accessibility-related standards by Hodgkinson for the CARDIAC European project [2], and the standards inventory in ISO/IEC TR 29138-2 [3]. As a result of this analysis, we have found the existence of overlapping and contradictions between available standards to manage accessibility issues and dynamic support in terms of i) users’ models, ii) learning scenarios, iii) interaction preferences, iv) devices capabilities, and v) metadata for specifying the delivery of any resource to meet users’ needs.

A proposal of a general infrastructure consisting of several standards-based interoperable components integrated into an open web service architecture of services aimed at supporting adapted interaction to guarantee students’ accessibility needs at higher education has been developed at the EU4ALL project [4].

In Table 1 we compile those standards that have a special emphasis on addressing accessibility and usability when dealing with e-learning settings. A set of combined criteria has been used to classify them:

1. Scope, which is divided into user and back end. “User end” has been used to label documents on accessibility user requirements and documents on accessibility guidance for designing/developing user interfaces, while “Back end” labels documents that provide guidance for designing/developing system components that support accessibility but are not part of the user interface.
2. Interaction area, which in turn, can refer to any of the following: Content, User, Device (including hardware and software), Adaptation, and User Interfaces.

<table>
<thead>
<tr>
<th>Standard / Specification</th>
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<th>Interaction area</th>
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<td>ISO/IEC 19788</td>
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<td>W3C WAI UAAG</td>
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</tr>
<tr>
<td>W3C WAI WCAG 2.0</td>
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<td>X</td>
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</table>

*Table 1 - Standards and specifications to describe accessibility issues in e-learning scenarios*
It can be seen that there is no single standard able to model this context and the application of a combination of several of them results in overlaps and gaps. There are many conflicting standards that address the same issues but with different views, or that apply to different areas [5, 6].

References


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E-learning internationalization standards overview and guidelines

Introduction

There exists a need for educational institutions providing cross-countries learning material and e-learning tools for multicultural students. To support their learning activities, these institutions frequently use a learning management system (LMS) which should provide specific internationalization features. This paper presents a review of the main standards and specifications proposed in this field. Finally, a list of guidelines is included for stakeholders who are considering dealing with a LMS and concerned with internationalization issues.

E-learning standards provide common concepts and practices that encourage interoperability and technology transfer. There are many international organizations working on the standardization of e-learning systems (ELS), such as ADL, AICC, CEN, IMS, ISO, and IEEE, among others.

Internationalization (i18n) is the process of designing a software application so that it can be adapted to various languages and regions without engineering changes.

Roles and uses

Several kinds of stakeholders can be interested in the ELS internationalization standards and specifications. The main roles identified are [1]:

- Role 1, e-learning system developer. Software developers that use the internationalization documentation as a source for the requirements specification document; authors, for whom the internationalization documentation provide a framework of reference when developing and publishing the contents.
- Role 2, e-learning system auditor. E-learning system administrators, subject tutors, accreditors or even learners can employ the internationalization documentation when evaluating, selecting or installing particular tools for an intended use, used or rephrased as checklists. In order to audit and guarantee the quality of e-learning products, some organisms (the so called Certification Authorities) can confirm or certify the fulfilment of particular internationalization standards either general or educational.

This paper focuses on the internationalization requirements (reqs hereafter), which could be used by any of these roles either for development or audit uses.

E-learning internationalization

The main standardization bodies have created e-learning internationalization groups, for example: ISO/IEC JTC 001/SC 36/WG 07 ITLET - Culture, language and individual needs [2]. However, after reviewing the literature, we have not found standards or specifications directly addressed to this topic. All of the internationalization information is spread out over several standards:

- ISO/IEC 24751-[1-3]:2008. Information technology - Individualized adaptability and accessibility in e-learning, education and training. In ISO/IEC 24751, disability is not considered as a personal trait but as a consequence of the relationship between a
learner and a learning environment or resource delivery system. In particular, a lack of language proficiency can produce a mismatch of personal needs and preferences with education digital resources.

- **ISO 9241.** Ergonomics of human-system interaction. The Part 151: Guidance on World Wide Web user Interfaces, provides guidance on the human-centered design of software Web user interfaces with the aim of increasing usability. In our work, the Section 10 (General design aspects) has been used for designing for cultural diversity and multilingual use in the web application. Other parts of this standard on accessibility and design are also relevant.

- Different standards of the **European Committee for Standardization (CEN)** [3] provides recommendations. For example: CWA 14929 (Internationalisation of SIF), includes recommendations on data coding, date formats, currency, etc., which can be generalized as internationalization reqs. Other standards CEN as LOM internationalization and vocabulary standards should also be taken into account.

- The **W3C Internationalization (I18n) Activity** [4] works with W3C working groups and liaises with other organizations to make it possible by using Web technologies with different languages, scripts, and cultures. Also, Web Content Accessibility Guidelines 2.0 covers a wide range of recommendations for making Web content more accessible.

**Guidelines**

After reviewing the literature, a brief, non-exhaustive list of guidelines, is provided to be considered by the stakeholders:

- The tool shall allow us to take into account all individual (even collective) information that may vary depending on an different educational/cultural context, by a profile or personal needs and preferences statement (PNP). In this issue, the ISO/IEC 24751-2 provides a full specification on accessibility which includes internationalization, and it is supplemented by other information sources as ISO 9241-151.

- The tool environment should fulfill and adapt to needs and preferences of the individual and collective users. Aspects such as allowing to select language, data coding, date format, screen enhancement (text design, colors, images, style sheet, etc.), structural presentation and alternative access systems should be considered. CWA 14929 provides important recommendations accordingly.

- Authors must define metadata that describe the contents and adaptations. ISO/IEC 24751-3 defines accessibility metadata that are able to express a resource's ability to match the needs and preferences of a user, as described by their PNP, already defined in ISO/IEC 24751-2.

- Content should be developed to enable easy adaptation of its presentation or structure to changing user requirements in order to allow delivery in different contexts. This can be facilitated by keeping the content, its structure and presentation independent of each other.

- The vocabulary in the tool (environment, documentation, help) should be defined in accordance with the standards.
Conclusions

In order to cover a wide range of i18n ELS reqs, not only specific e-learning must be beared in mind, but other general standards and specifications, such as those mentioned in this paper, should be considered too. Regarding the internationalization concept itself, we think that more precise definitions are needed, in order to determine whether a particular aspect or feature concerns internationalization specifically or not, in particular in those standards that include it as part of the accessibility concept.

References


**IMS-LD Technological Limitations to Design and Create Adaptive Learning Paths**

**Overview**

IMS Learning Design⁹ (IMS-LD) is a specification that proposes a metalanguage to describe all the elements related to the learning process itself. The specification is understood as a stage-play approach: people act in different roles, roles work towards specific objectives by performing learning and/or support activities, and activities are conducted within an environment that consists of learning objects and services.

Use of IMS-LD is very scarce [1, 2] and most examples are limited to specific scenarios that cannot be utilised for online learning experiences. This paper is based on the largest experience that uses IMS-LD to specify adaptive learning paths and run them, in a virtual environment at the Open University of Catalonia (UOC). This paper details key technological problems found in using IMS-LD tools and how issues were solved.

**Step 1: Designing adaptive learning paths using IMS-LD**

This experience involves creating Adaptive Learning Paths (ALP) in the subject of Logics, within the Computer Science’s Bachelor program at UOC. Some sections of the Logic subject are used to explain the shortcomings of IMS-LD.

As a result of a pedagogical study, three ALP for Logic subject, were designed (Figure 1). Each path focused on a different learner profile. At the beginning of the process, learners follow one path according to their preliminary knowledge, but during the course they will be able to change path.

![Figure 1 - Example of Adaptive Learning Paths for Logics subject](http://www.imsglobal.org/learningdesign/)

In order to specify paths according to IMS-LD we used the entity *play* to represent the subject and the class *act* to describe learning paths. Each *play* contains a series of sequential *acts* and these activities and resources are related to with one learner role. Following this structure, learning paths can be created using the Level A of IMS-LD. But Level B is required if adaptability needs to be added.

**Step 2: Adding adaptability with IMS-LD Level B**

Adaptive learning system allows the activity sequence to be changed according to different rules based on learner profile. Each of the three learning paths contains four *acts* with four

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⁹ [http://www.imsglobal.org/learningdesign/]
activities. Each one addresses a different learner profile: path 1, linked to learner role 1, is for students with a low level background in mathematics and programming; path 2, associated to learner role 2, is for students with some competences in the subject and path 3, linked to role 3, is for learners with a rich background and knowledge about the subject. After an initial test, learners are introduced to the most appropriate learning path.

During the course, adaptively is introduced by the evaluation of each activity [3]. According this input, ALP system allows identifying the new learner profile and providing him with another learning path. Therefore, learners can change their learning path to follow a different one. Conditions and properties from Level B of IMS-LD are used to change the learner role (i.e. from learner role 3 to learner role 1).

Step 3: IMS-LD compliant tools

IMS-LD provides a generic and flexible XML based language. An editor tool is used to create the XML schema and a player tool is needed to execute the XML schema. In order to choose the best tools, an analysis, resumed in Table 1, has been conducted.

<table>
<thead>
<tr>
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<th>Multiplatform</th>
<th>Remote edition</th>
<th>Open source</th>
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<td>B</td>
<td>C</td>
<td></td>
<td></td>
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<tr>
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<td>✓ -- --</td>
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<table>
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</table>

Table 1. Analysis of editors and players

To work with Level A and B, ReCourse editor (v.2.0.3) and CopperCore (v.3.2) player, were selected.

Problems found and solutions followed

During our experience both, editor and player, have shown some limitations. The three learning paths were difficult to manage using the editor because each learning path had to be created individually. In addition, CopperCore failed often when executing some units of learning created with ReCourse. It does not allow uploading several files at once, and hence several conditions and properties may not work in runtime. Finally, the main shortcoming found with the player was the impossibility of changing learner role on runtime. Although according the tools and the information model of IMS-LD it should be possible it is not described how to proceed. At this point we analysed other tools for changing learners’ role with IMS-LD level B in runtime and provide learners with a really adaptive system.
To solve the aforesaid shortcomings with the editor it was necessary to edit XML files for each learning path with a plain text editor.

To load IMS-LD courses with CopperCore, we manually edited the file by removing any reference to “ldauthor” or “ld-author.xsd”, which are automatically included by ReCourse and referenced in the imsmanifest.xml file. A PHP script has been written to automate the process of removing such references.

For changing learner’s role with Level B we worked with an additional tool included on CopperCore player called clicc. It allows changing learner role in runtime and, consequently, change learners to another learning path according their new profile. Thus improving adaptivity focused on each activity output and introducing new ways to work on adaptive learning paths using IMS-LD.

Conclusion

With some technological improvements in the IMS-LD tools, adaptive learning paths can be completely performed into a virtual learning environment. However, editors and players need to be improved in future research. This experience had shown a first step to introduce adaptively in a learning process but it needs to be tested in other subject or virtual learning environments.

References


Regular Articles Section
OP4L project report

OP4L is a 2-year international project, funded by the European Commission within its SEE-ERA.NET PLUS program (project ERA 115/01), with the objective to provide support for advanced, context-aware Learning Process Management (LPM) within Personal Learning Environments (PLEs) as the increasingly important paradigm in online education [Attwell, 2007]. The project relies on using Social Semantic Web (SSW) technologies [Mikroyannidis, 2007] to generate recommendations for learners, based on their current learning contexts and the state of online presence of members of their social graphs (i.e., network of online connections).

Introduction

OP4L stands for Online Presence for Learning. Online Presence refers to temporary descriptions of users’ presence in the online world [Stankovic, 2008]. Most instant messaging tools and social networking services allow users to post descriptions of their temporary state: custom messages, availability and willingness to chat and often visual representations known as avatars. The activity of maintaining this kind of temporary user profiles is no more than creating an image of someone’s presence in the online world, a representation how one wishes to be seen by their contacts – the person's online presence.

The objective of the OP4L project is to develop different kinds of services for the benefit of online learners based on their online presence. The services should provide learners with high-quality recommendation regarding the learning activities to be taken, the learning content to be used, and/or who can be contacted for collaboration and/or help provision. All the recommendations should be based on the learner’s current learning context and the state of online presence of members of his/her social graph (i.e., network of online connections).

Project Description

Research and development in the OP4L project is conducted in several inter-related directions:

- Study of the concept of online presence, especially in the context of online learning environments [Stankovic, 2009].
- Study of pedagogical issues underlying PLEs, in particular: interactivity, social learning, collaboration, learners’ autonomy, and self-regulation.
- Development of ICT models that raise learners’ awareness of each other’s (online) presence in online collaborative learning [Jovanovic et al, 2009]. By being aware of a learner’s online presence, a learning system can adapt the learner’s interactions with his/her online social environment (i.e. other learners and teachers) better.
- Learning context modeling. Learning context is about the environment, tools, resources, people (in terms of social networking), and learning activities [Jovanovic et al, 2007]. In OP4L, this notion of learning context is extended with the notion of online presence.
- Recommendation of relevant learning resources. Context-aware and online-presence-aware recommendation of relevant learning resources (both digital and human) is the major practical focus of OP4L. To this end, the project develops and demonstrates the use of specific algorithms for context-aware recommendation of learning resources. A specific PLE, called DEPTHS [Jeremic et al, 2009], developed for collaborative
learning of software design patterns, is extended with the notion of online presence and is used to demonstrate how taking into account the learners' online presence helps in several learning scenarios when collaboration options would otherwise be greatly reduced.

Results

All of the project results are available from the project Web site as they come – reports, deliverables, and software. The most interesting result is the DEPTHS PLE, extended with online presence of the learners. Figure 1 shows an example of interaction between DEPTHS and Facebook users. DEPTHS, being a PLE, integrates several other tools. One of them is ArgoUML, a software design tool; another one is Moodle, a popular learning management system. Learner A, logged in DEPTHS for the design patterns course, is solving a software design problem. The "Online presence" box in the upper left part of the screen shows peers available to help him. If they are not online in Moodle, learner A can contact them using Facebook or Twitter, as the "Online presence" box indicates that some of them are available through (i.e., are currently online in) these other services. If learner B happens to be available on Facebook, learner A can click the Facebook icon next to learner B's name in the "Online presence" box and get a popup window for sending a message to learner B (a request for help). Learner B will see a notification in his Facebook account, with the message that his colleague sent him. If learner B accepts it, he will get access to the learner A's design problem through the Facebook application, i.e. a Moodle page showing this problem will be integrated in learner B's Facebook application. So, learner B does not have to leave Facebook if he wants to help his colleague.

![Software Design Patterns](image)

**Figure 1 - Interaction between DEPTHS and Facebook**

The project deliverables (reports) available from the project Web site contain a lot of details related to online presence in the context of online learning environments, ICT models, algorithms, and learning context ontologies developed, as well as how DEPTHS is used in practice.
Future Work

It is expected that by the end of the project DEPTHS (extended with online presence services) will be actively in use in courses delivered at partner universities that cover the topic of software design patterns. Through a thorough testing and evaluation of the environment itself, experience will be gained to let the project partners generalize online presence services for learning and create guidelines for other PLEs in terms of how to include these services. Dissemination and demonstration activities are expected to attract attention of a wider PLE community.

References


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PhD Abstracts Section
The present thesis focuses on 3D virtual collaborative learning environments and their application in order to effectively support the pedagogical context, which is necessary for the facilitation of collaborative learning. The thesis was constructed around three fundamental research questions: a) "How can 3D virtual collaborative learning environments efficiently support traditional face to face collaborative learning techniques from a distance?", b) “What are the design specifications for a suitable evaluation methodology, exclusively for 3D virtual collaborative learning environments?”, and c) “How does user representation through avatars influence the collaboration and performance of the collaborating teams?”.

Answering the aforementioned questions required the study and analysis of topics relating to selecting, designing and evaluating 3D virtual collaborative learning environments. This study took place on both a theoretical and practical level.

Special attention was given to evaluation methodologies. After identifying a research gap, the thesis proposes a novel approach which examines both the functional characteristics and educational capabilities offered by the virtual environment. This methodology was published as an article in an international journal: “Tsiatsos, Th., Konstantinidis, A. & Pomportsis, A. (2010). Evaluation Framework for Collaborative Educational Virtual Environments, Journal of Educational Technology and Society, 13 (2), 65–77”.

Furthermore, the contribution of the thesis arose from a thorough study of relevant literature and from the realization of five research activities with the participation of a total of 82 undergraduate and postgraduate students.

Based on the overall results of the research activities, it was concluded that a 3D virtual collaborative learning environment cannot completely replace the traditional method of collaboration. It can, however, be utilized as the online portion of a blended learning approach, strengthening and renewing the traditional approaches to learning and collaborating. Also, a minority of the participants of the research activities remained doubtful regarding the educational value of this collaborative approach to learning. On the other hand, however, most participants express their interest regarding the support of lectures and educational activities through a suitably designed virtual environment.

Summarizing the overall contribution of the thesis through the form of short, succinct statements, it is noteworthy to mention that:

1. Fundamental design principles which contribute to the qualitative transformation of learning spaces into learning places, regardless of the applied collaborative technique, were identified and implemented. These design principles take into consideration four basic factors which enhance the immersion of students in the educational experience: interest, involvement, imagination and interaction. Through immersion, students are motivated and gain an active relationship with the material being taught and understand its importance.

2. An original methodology for evaluating collaborative educational virtual environments was developed. This methodology aids researchers in: a) identifying usability issues, b) collecting additional functionality requirements for the support of
collaborative learning, and c) validating the suitability of different types of educational scenarios.

3. With regards to the traditional collaborative learning techniques, whose online transferability was assessed, it was concluded that due to the lack of shared applications and reduced file sharing capability in the 3D virtual collaborative learning environment, support of the Jigsaw technique is limited to an organizational and representational level. In other words, even though the required team dynamics are simulated adequately, collaboration is not sufficiently supported due to the lack of fundamental functionality and capabilities. On the other hand, both the organizational and functional requirements of the Fishbowl technique were adequately supported through the implemented metaphors, avatar representation and VoIP communication.

4. Finally, it seems worthwhile to explore the development of new practices in distance education using a combination of 3D virtual collaborative learning environments and 2D learning management systems. This investigation should also focus on the development of suitable, user friendly functionality, which will allow educators, quickly and easily, to use elements such as virtual tools, simulations and metaphors in order to exploit the representational capabilities that are offered in a 3D virtual environment.

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