Organizing E-learning Standards and Specifications

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Abstract - *Nowadays there are a lot of standards, specifications and recommendations developed by different organizations, which the aim of providing a common framework in order to regulate the various aspects related to the development and use of e-learning environments. This paper provides a compilation of major e-learning standards that exist today, and all of them have been classified in twelve different categories, according to their main area of application*.

Keywords: eLearning standards, eLearning technologies, eLearning quality.

1 Introduction

In order to provide an instrument that can be useful to those involved in the development of standards-based e-learning: suppliers, consumers, platform designers, content authors, among others; in this paper an exhaustive classification of the best-known standards is showed.

The classification has been developed taking into account the work of other authors, including those referenced [1, 2, 3, 4] and other initiatives for the classification of e-learning standards, highlighting the important work done in this regard by LTSO Observatory (Learning Technology Standards Observatory) (http://www.cen-ltso.net), who has served as an obligatory reference in the classification presented in this paper.

Although many documents make a distinction between concepts as "standard", "specification" and "recommendation"; as the main goal in all cases is create a common language, we have decided to use in this paper the term "standard" to refer to them all, taking into account that in some cases these standards are "de jure" standards and in other cases "de facto". The rest of the paper is organized as follows: in the next section the classification criteria of the standards identified is described, which has resulted in twelve different categories. Section 3 presents 107 standards organized by category. And finally, last section is devoted to discuss some conclusions from the work done.

2 Classification criteria

The definition of categories that structure the classification has followed these criteria:

- The categories have been created taking into account the total of 107 different standards compiled and the area covered by each of them.
- A category is considered only if it deals with one aspect of e-learning sufficiently important in the process of creating learning management systems, or learning resources.
- There must be, to the extent possible, a reasonable number of standards into each category, so as to avoid creating particular standards for particular categories. In these cases, the standard has been subsumed in a broader category.
- Categories must be defined in order to future standards, currently under development, can be classified without undergoing any changes.
- Within the categories, a standard can be included, although it is not directly related to e-learning, but if it can be essential when developing e-learning. Some of these standards are XML or HTML.

On the basis of these criteria, and considering the LTSO initiative and the Guide by Hilera and Hoya [5], the following classification with twelve different categories has been established:

1. **Accessibility**: It is Included in this category all those standards that facilitate access to virtual educational resource to any person, with or without disabilities, and those who are defined to adapt the user interface.
2. **Architecture**: Standards that defining software or hardware architectures for e-learning systems, and useful and effective protocols for such systems.
3. **Collaboration**: Standards that facilitate the exchange of information in run-time e-learning systems, and those standards whose goal is to resolve hardware or

software incompatibilities that this exchange of information can present.

4. **Competencies**: Standards dedicated to creating a useful model of student competence, and the standards that deal to distribute the information about competences among different systems. A "competence" is defined as that measurable characteristic, skill or expertise that can be required to perform a specific job or task.

5. **Content and Assessment**: Standards set for learning content management, including aggregation models and content exchange and packaging. Also the standards about knowledge assessment.

6. **Digital Repositories**: Standards describing the content and development of digital repositories, and those that provide information models and protocols to enable interoperability between different repositories, both for search operations and for publication and storage through the Web.

7. **Digital Rights**: Standards related to the expression, management and delivery, or authorization of content considering digital rights.

8. **Learner Information**: Standards that address the storage and management of information about a student or a group of them, in an e-learning environment.

9. **Learning process**: Standards that help to define pedagogical theories or sequencing of content, in order to adapt the learning process to each student according to his or her interaction with a learning management system.

10. **Metadata**: Standards relating to the identification or management of metadata sets applicable to virtual learning.

11. **Quality**: Standards developed in order to ensure quality in e-learning, including those that help in the creation of quality approaches for the development of e-learning products, and those based on a series of well-defined criteria and indicators for the evaluation of any platform or content related to virtual learning.

12. **Vocabulary and languages**: Standards to define vocabularies or languages that promote understanding and exchange of information throughout the virtual learning process, and those who try to minimize the impact that the implementation of a language or vocabulary may have in different geographic areas due to linguistic or cultural differences.

The LTSO initiative collects about 70 standards organized in 18 categories, compared to the total of 107 standards organized into 12 categories shown in this work. Although the categories defined by the LTSO initiative do not coincide with the classification described in this paper, both may be compatible in some way, as both try to sort and organize the different specifications and community initiatives about standardization in eLearning.

3 Standards classified

As already indicated, it is classified a total of 107 standards in 12 categories. Tables 1-12 indicate the titles of these standards, as well as the organization that has published each of them and the year of the last version published. The details about the complete name and URL of the organizations are shown in figure 1.

Table 1. Standards classified in the category "Accessibility" (Shared standards are equivalent)

Standard	Org.	Year
UNE 139801, Computer applications for people with disabilities. Computer accesibility requirements. Hardware.	AENOR	2003
UNE 139802, Computer applications for people with disabilities. Computer accesibility requirements. Software.	AENOR	2009
UNE 139803, Computer applications for people with disabilities. Web content accesibility requirements.	AENOR	2004
AGR009,Icon Standards: User Interfaces.	AICC	1996
Guidelines for the "Access for All" Digital Resource Description Metadata Elements	CANCORE	2009
IMS AccessForAll Meta-data (IMS ACCMD).	IMS	2004
IMS Guidelines for Developing Accessible Learning Applications (IMS DALA).	IMS	2005
IMS Learner Information Package Accessibility for LIP (IMS ACCLIP).	IMS	2003
ISO 9241-171, Ergonomics of human-system interaction. Part 171: Guidance on software accessibility.	ISO	2008
ISO/IEC 24751-1, Individualized adaptability and accessibility in e-learning, education and training.	ISO/IEC	2008
ISO/IEC 24751-2, Part 2: "Access for all" personal needs and preferences for digital delivery.	ISO/IEC	2008
ISO/IEC 24751-3, Part 3: "Access for all" digital resource description.	ISO/IEC	2008
W3C, Accessible Rich Internet Applications (WAI ARIA)	W3C	2009
W3C, Authoring Tool Accessibility Guidelines (WAI ATAG)	W3C	2000
W3C, Web Content Accessibility Guidelines (WAI WCAG)	W3C	2008

Table 2. Standards classified in the category "Architecture"

Standard	Org.	Year
AGR011, CBT Package Exchange Notification (PENS)	AICC	2005
AGR002, Courseware Delivery Stations	AICC	2002
Content Object Repository Discovery and Registration/Resolution Architecture (CORDRA)	CORDRA	2005
IEEE 1484.1, Learning Technology Systems Architecture (LTSA)	IEEE	2003
IMS Abstract Framework (IMS AF)	IMS	2003
IMS General Web Services (IMS GWS)	IMS	2005
IMS Tools Interoperability (IMS TI)	IMS	2006
Open Architecture and Schools in Society (OASIS)	OASIS	2004
Open Knowledge Initiative (OKI)	OKI	2004
Schools Interoperability Framework (SIF)	SIF	2008

Table 3. Standards classified in the category "Collaboration" (Shared standards are equivalent)

Standard	Org.	Year
ADL SCORM Run-Time Environment (SCORM RTE)	ADL	2006
AICC/ CMI Guidelines for Interoperability	AICC	2004
CWA 14928, Review on SIF Infrastructure, Architecture, Message Processing and Transport Layer	CEN	2004
CWA 14929, Internationalisation of SIF and harmonisation with other specs/standards	CEN	2004
CWA 15155, Adaptation of SIF (Schools Interoperability Framework) Data Model for a European context	CEN	2004
IEEE 1484.11.1, Data Model for Content to Learning Management System Communication	IEEE	2004
IMS Sharable State Persistence (IMS SSP)	IMS	2004
ISO/IEC 19778-1, ITLETCT, Collaborative workplace	ISO/IEC	2008
ISO/IEC 19778-2, Collaborative workplace, Part 2: Collaborative environment data model	ISO/IEC	2008
ISO/IEC 19778-3, Collaborative workplace, Part 3: Collaborative group data model	ISO/IEC	2008
ISO/IEC 19780-1, CB, Collaborative Learning Communication part1	ISO/IEC	2008
ISO/IEC TR 29163-1, IT Sharable Content Object Reference Model (SCORM®) 2004 3rd Edition, Part 1: Overview Version 1.1	ISO/IEC	2009
ISO/IEC TR 29163-3, IT Sharable Content Object Reference Model (SCORM®) 2004 3rd Edition, Part 3: Run-Time Environment Version 1.1	ISO/IEC	2009

Table 4. Standards classified in the category "Competencies"

Standard	Org.	Year
CWA 14927, Recommendations on a Model for expressing learner competencies	CEN	2004
CWA 15455, A European Model for Learner Competencies	CEN	2005
HR-XML Competencies	HR-XML	2007
IEEE 1484.20.1, Data Model for Reusable Competency Definitions (DMRCD)	IEEE	2008
IMS Reusable Definition of Competency or Educational Objective (IMS RDCEO)	IMS	2002

Table 5. Standards classified in the category "Contents and Assessment" (Shared standards are equivalent)

Standard	Org.	Year
ADL SCORM Content Aggregation Model (SCORM CAM)	ADL	2006
AGR006, Computer Managed Instruction (CMI)	AICC	1998
AGR007, Courseware Interchange	AICC	1995
AGR010, Web-based Computer Managed Instruction (CMI)	AICC	1998
CMI 012, AICC Packaging Specification	AICC	2006
IMS Common Cartridge (IMS CC)	IMS	2008
IMS Content Packaging (IMS CP)	IMS	2004
IMS Question and Test Inteoperability (QTI)	IMS	2005
IMS Resource List Interoperatibility (RLI)	IMS	2004
ISO/IEC 12785-1, ITLET Content packaging, Part 1: Information model	ISO/IEC	2009
ISO/IEC 23988, A code of practice for the use of information technology (IT) in the delivery of assessments	ISO/IEC	2007
ISO/IEC TR 29163-2, IT Sharable Content Object Reference Model (SCORM®) 2004 3rd Edition, Part 2: Content Aggregation Model Version 1.1	ISO/IEC	2009
OAI, Object Reuse and Exchange (ORE)	OAI	2008

Table 6. Standards classified in the category "Digital Repositories"

Standard	Org.	Year
CWA 15454, A Simple Query Interface Specification for Learning Repositories (SQI)	CEN	2005
CWA Simple Publishing Interface for Learning Object Repositories (SPI)	CEN	2009
IMS Digital Repositories Interoperatibility (DRI)	IMS	2003

Table 7. Standards classified in the category “Digital Rights"

Standard	Org.	Year
XRML, Extensible Rights Markup Language	Content Guard	2002
IEEE 1484.4, Trial Use Recommended Practice for Digital Rights Expression Languages Suitable for eLearning Technologies (DREL)	IEEE	2007
IMS Common Cartridge Authorization Web Service (IMS CCAWS)	IMS	2008
OMA Digital Rights Management (OMA-DRM)	OMA	2008
Open Digital Rights Language (ODRL)	ODRL	2002

Table 8. Standards classified in the category “Learner Information"

Standard	Org.	Year
CWA 14926, Guidelines for the production of learner information standards and specifications	CEN	2004
IEEE P1484.2, Public And Private Information Learner (PAPI)	IEEE	2002
IMS Enterprise (IMS E)	IMS	2002
IMS Enterprise services (IMS ES)	IMS	2004
IMS ePortfolio (IMS eP)	IMS	2005
IMS Learner Information Package (IMS LIP)	IMS	2005
ISO/IEC 24703, Participant Identifiers	ISO	2004

Table 9. Standards classified in the category “Learning Process” (Shared standards are equivalent)

Standard	Org.	Year
ADL SCORM Sequencing and Navigation (SCORM S&N)	ADL	2006
IMS Learning Design (IMS LD)	IMS	2003
IMS Simple Sequencing (IMS SS)	IMS	2003
ISO/IEC TR 29163-4, IT Sharable Content Object Reference Model (SCORM®) 2004 3rd Edition, Part 4: Sequencing and Navigation Version 1.1	ISO/IEC	2009

Table 10. Standards classified in the category “Metadata” (Shared standards are equivalent)

Standard	Org.	Year
UNE 71361, LOM-ES application profile for standarized Digital Learning Objects metadata.	AENOR	2009
CanCore Element Set	CANCORE	2002
CWA 14855, Dublin Core Application Profile Guidelines	CEN	2003
Dublin Core Metadata	DCMI	2008
EdNA Metadata	EdNA	2002
IEEE 1484.12.1, Learning Object Metadata (LOM)	IEEE	2002
IMS Learning Resource Meta-data Specification (IMS MD)	IMS	2006
ISO 15836, The Dublin Core Metadata Element Set (DCEMES)	ISO/IEC	2009
LORN Vetadata	LORN	2008
OAI, Protocol for Metadata Harvesting (PMH)	OAI	2002
ProLEARN, Harmonization of Metadata Standards	PROLEARN	2008

Table 11. Standards classified in the category “Quality”

Standard	Org.	Year
UNE 66181, Quality management. Quality of virtual education.	AENOR	2008
CWA 14644, Quality Assurance Standards	CEN	2003
CWA 15533, A model for the classification of quality approaches in eLearning	CEN	2006
CWA 15660, Providing good practice for E-Learning quality approaches	CEN	2007
CWA 15661, Providing E-Learning supplies transparency profiles	CEN	2007
EFQM Excelence Model	EFQM	1999
UNIQUE, European University Quality in eLearning	EFQUEL	2006
ISO 9001, Quality management systems, Requirements	ISO/IEC	2008
ISO/IEC 19796-1, ITLET Quality management, assurance and metrics, Part 1: General approach	ISO/IEC	2005
ISO/IEC 19796-3, ITLET Quality management, assurance and metrics, Part 3: Reference methods and metrics	ISO/IEC	2009
ISO 29990, Learning services for non-formal education and training, Basic requirements for service providers	ISO	2010
Code of practice for the assurance of academic quality and standards in higher education. Section 2: Collaborative provision and flexible and distributed learning.	QAA	2004

Table 12. Standards classified in the category “Vocabulary and Languages”

Standard	Org.	Year
AICC/ CRS002 Glosary of Terms Related to Computer-Based Trainning	AICC	2003
CWA 14590, Description of Language Capabilities	CEN	2002
CWA 14643, Internationalisation of the IEEE Learning Object Metadata	CEN	2003
CWA 14645, Availability of alternative language versions of a learning resource in IEEE LOM	CEN	2003
CWA 14871, Controlled Vocabularies for Learning Object Metadata: Typology,	CEN	2003
CWA 15453, Harmonisation of vocabulares for eLearning	CEN	2005

Standard	Org.	Year
CWA 15555, Guidelines and support for building application profiles in elearning	CEN	2006
IMS Application Profile Guidelines(IMS AP)	IMS	2005
IMS Vocabularies Definition Exchange -VDEX	IMS	2004
ISO/IEC 2382-36, IT, Vocabulary Part 36: Learning, education and training	ISO	2008
ISO/IEC TR 24725-3, ITLET Supportive technology and specific integration, Part 3: Platform and Media Taxonomy (PMT)	ISO/ IEC	2010
CSS, Cascading Style Sheets	W3C	2008
HTML, Hypertext Markup Language	W3C	1999
XML, Extensible Markup Language	W3C	2008

4 Conclusions

The proliferation of heterogeneous educational applications using the Web, and the commercial interest of these applications has led to a natural process of standardization of various aspects of educational technology.

The main objective pursued is the reusability and interoperability of educational content between different systems and platforms. As we have seen, there are a large number of institutions, organizations and projects behind this process, making it difficult to predict the future about the standardization in the field of e-learning.

ADL	Advanced Distributed Learning	www.adlnet.org
AENOR	Spanish Association for Standardization and Certification	www.aenor.es
AICC	Aviation Industry CBT Committee	www.aicc.org
CANCORE	Canadian Core	www.cancore.ca
CEN	European Committee for Standarization	www.cen.eu
Content guard	Content Guard	www.contentguard.com
CORDRA	Content Object Repository Discovery and Registration/ Resolution Architecture	www.cordra.net
DCMI	Dublin Core Metadata Initiative	www.dublincore.org
EdNA	Educational Network Australia	www.edna.edu.au
EFQM	European Foundation for Quality Management	www.efqm.org
EFQUEL	European Foundation for Quality in e-Learning	www.efquel.org
HR-XML	Human Resources- XML Consortium	www.hr-xml.org
IEEE	Institute of Electrical and Electronics Engineers	www.ieee.org
IMS	IMS Global Learning Consortium	www.imsglobal.org
ISO/IEC	International Organization for Standarization	www.iso.org
LORN	Learning Object Repository Network	http://lorn.flexiblelearning.net.au
OAI	Open Archives Initiative	www.openarchives.org
OASIS	Open Architechture and Schools in Society	http://oasis.cnice.mec.es
ODRL	Open Digital Rights Languaje	www.odrl.net
OKI	Open Knowledge Initiative	www.okiproject.org
OMA	Open Mobile Alliance	www.openmobilealliance.org
PROLEARN	Professional Learning	www.prolearn-project.org
QAA	Quality Assurance Agency for Higher Education	www.qaa.ac.uk
SIF	Schools Interoperability Framework	www.sifinfo.org
W3C	World Wide Web Consortium	www.w3.org

Figure 1. Organizations responsible of publishing classified standards

It seems an accepted fact that the standardization of e-learning is necessary in order to get a quality education through the Web. This is because the creators of educational systems and content need working patterns that allow them to pool their efforts. As a result, will be possible, for example, that the authors can improve the content rather spend their time creating them from scratch, define mechanisms for reuse/authoring of educational content, and adapt the process to specific learning needs of students.

The aim of this work is to provide an overview of the current situation of heterogeneous e-learning standards, trying to gather the most relevant and making a classification that provides guidance to anyone interested.

As can be seen in Figure 2, 107 different standards have been classified into 12 categories. Categories about accessibility and about vocabulary and languages contain the greatest number of published specifications, and the categories about repositories and learning process, the least.

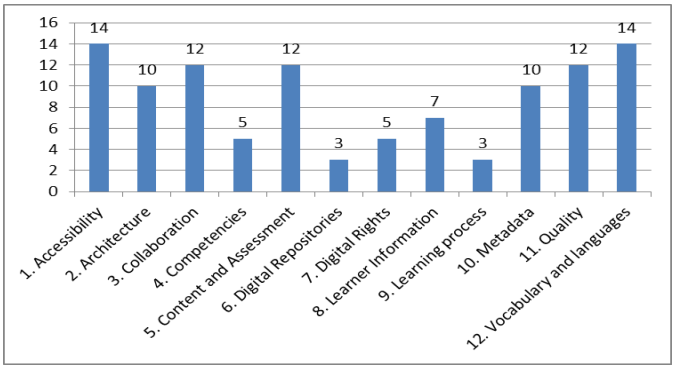

Figure 2. Statistics quality standards focused on the descriptive model.

This classification must be continuously updated, depending on the evolution of organizations for the standardization of e-learning, the creation of new organizations, as well as the evolution of the various emerging standards, and of those adopted or absorbed by other standards and organizations. In addition, over time, new categories of standards or modification of any of the proposals in this paper can be necessary.

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