e-Learnz

The NZ consortium for e-learning

e-Learning Standards Overview

Prepared for use with the e-Learnz ToolBox

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15/11/03	S. Harlow & C. Gibson	Draft 0.1	Initial release for discussion.
16/11/03	S. Harlow & C. Gibson	Draft 0.2	Dalziel Learning Object model is added.
21/11/03	C W Dashfield	Draft 0.3	Minor changes and comments for discussion added
9/1/04	S. Harlow & C. Gibson	Draft 0.4	Further text expansion
29/1/04	C. Gibson	Draft 0.5	Final draft for release
23/3/04	S. Harlow & C. Gibson	Version 1.0	Release document following final input from Stephen Harlow.

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1. Introduction

e-Learnz, a legally registered Incorporated Society, is a consortium of New Zealand polytechnics, universities, wananga and other organisations working in e-Learning for tertiary education, and aiming to become New Zealand's centre of excellence in the development and delivery of e-Learning.

The Ministry of Education has requested that e-Learnz prepare an overview of existing and emerging standards, and a set of recommendations for interim e-learning standards, for government funded collaborative e-Learning development projects is prepared.

This document provides an overview of the status of standards, and recommendations relevant to the current position.

2. Overview

The functions and dependencies of the ToolBox components, to be delivered initially, are illustrated in Figure 1 below:

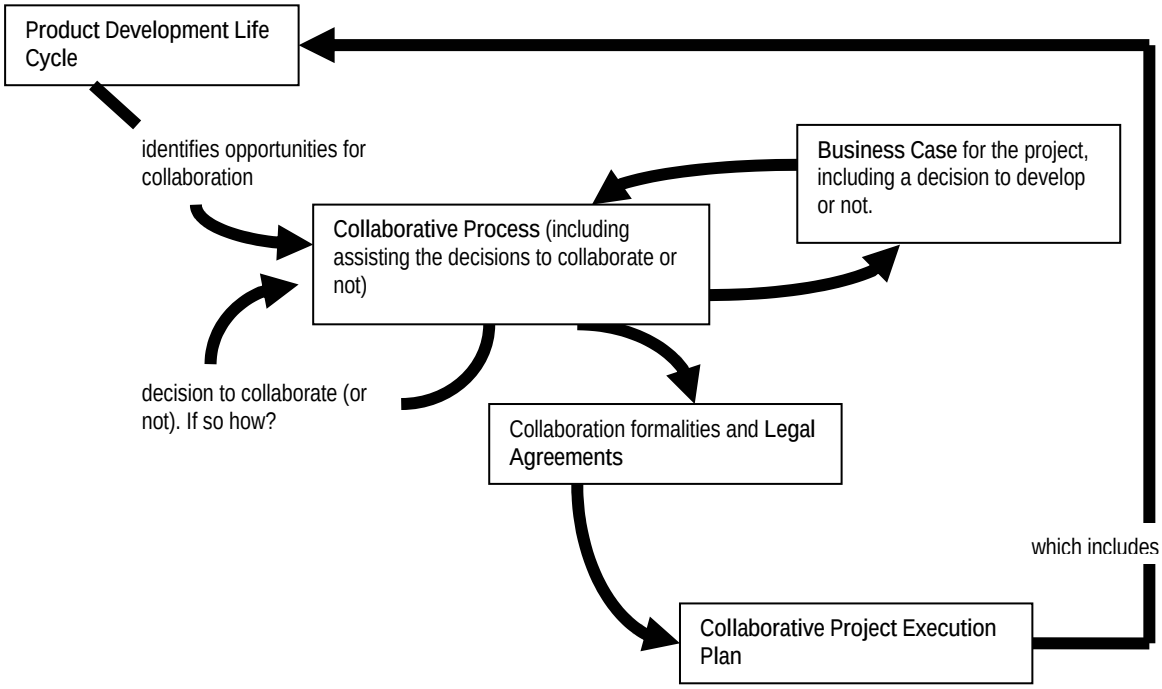


Figure 1 ToolBox components and Product Development

The standards issues identified in this framework should be applied to or considered at every point of this process.

3. How do standards occur?

The setting of standards is a long and complicated process that may take many years. Standards are established by generally statutory organisations who are concerned with "facilitating trade". The standards released by these organisations have been through intensive industry review and are typically internationally validated and authorised.

Much of what is termed "standards" are in fact specifications, models or exemplas, some of which could through extensive adoption become standards. As industries widely adopt these specifications, models or exemplas defacto standards are created.

In this document, the words standard and specification may be used interchangeably. Figure 2 shows the processes and bodies involved in establishing standards.

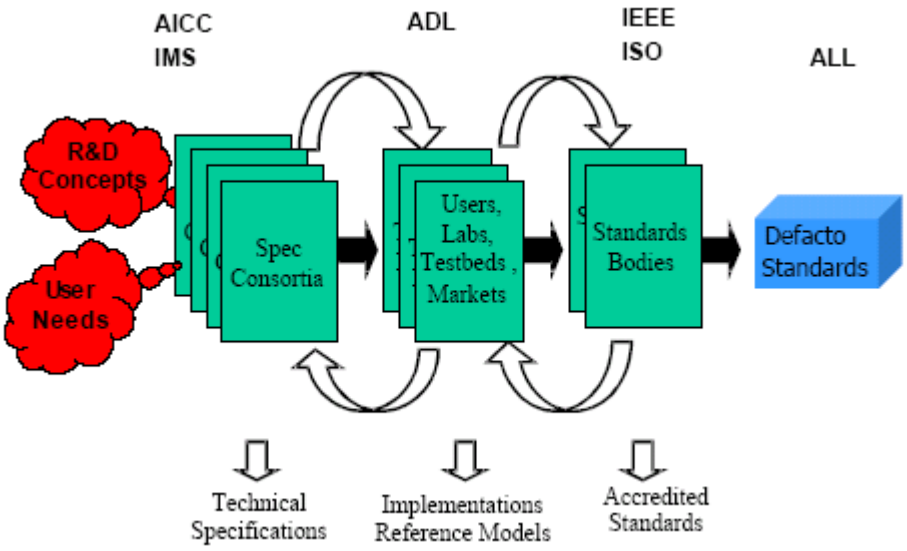


Figure 2 The standards setting process (Adapted from the Masie Centre, 2002).

Abbreviation		Organisation	Role / Characteristics
AICC	-	Airline Industry CBT Committee	Collaborative specification developers
ADL	-	Academic Advance Distributed Learning (ADL Co-Laboratory)	Specification developers and users / testers
IEEE	-	Institute of Electrical and Electronic Engineers	Standards accredited
IMS	-	IMS Global Learning Consortium	Collaborative specification developers
ISO	-	International Standardisation Office	Standards accredited

4. Why are standards important?

The development of e-learning content is an expensive and specialised undertaking that is well suited to collaboration. Different collaborative partners bring with them different technologies and in order to maximise return on investment and ensure e-learning content that is truly interoperable and not tied to one particular learning management system (LMS) such as Blackboard or WebCT, content must be described and accessed in standardised ways. Therefore, the creation of technical specifications and the development and widespread adoption of technical standards will be fundamental to the success of e-learning. To protect government investment and maximise likely return, it is vital that the standards adopted in New Zealand are emerging international standards that are most likely to be both ratified by standards bodies and widely taken up by e-learning developers.

Abbreviation		Full Name	Examples
LMS	-	Learning Management System	Blackboard and WebCT
LCMS	-	Learning Content Management System	

4.1 Specific exclusion

This document discusses the standards necessary to achieve accessibility, interoperability, flexibility, reusability, affordability, security and financial chargeability. Specifically excluded from this document are the pedagogical standards that are required to ensure that the instructional design and assessment components of e-learning are effective. However, the document acknowledges the potential conflict between instructional design, associated assessment and interoperability standards.

5. Attributes

The attributes necessary to ensure that there is effective collaboration in both the development of courseware and the sharing of courseware are summarised below:

5.1 Accessibility

The ability to locate and access instructional components from one remote location and deliver these to many other locations.

> E.g., a tutor conducts a search of multiple learning object repositories for content on religions of the world. Suitable content is located and downloaded as a content package and added to the tutor's course.

5.2 Interoperability

The ability to take instructional components developed in one location with one set of tools or platform and to use them in another location with a different set of tools or platform.

> E.g., a very successful business studies course has been developed which other institutions have expressed interest in adopting. Because this development used standards compliant tools, the potential for sharing the course with another institution exists because the other party has a standards compliant LMS. Sharing with another institution, without a standards compliant LMS would not be straight forward or as cost effective.

5.3 Durability

Durability means the ability to continue to use instructional components when technology changes, without redesign or recoding the content. By adopting standards compliance, you are ensuring the longevity of digital content.

> E.g., an institution decides to migrate to a new learning management system. Because both the existing LMS and the new LMS are standards compliant, student records and content can be moved from one to the other without disruption to the learner.

5.4 Reusability

Reusability in this context is the flexibility to incorporate instructional components in multiple learning applications and contexts.

> E.g., relevant content developed for an occupational health and safety unit standard can be easily incorporated into hospitality and automotive repair courses because the content was developed to be standards compliant.

5.5 Value

In addition to the potential cost effectiveness of collaboration, adopting standards significantly increases learning effectiveness while reducing time and costs.

> E.g., institutions that are standards compliant can more easily collaborate with other institutions to develop common content and take advantage of shared expertise and lowered production costs. This standards-based content will have a greater longevity, freeing development resources for other projects.

5.6 Digital Rights Management

The intellectual property rights of the owners of the courseware must be protected. This means that only authorized people can be allowed to access the material. Standards must be agreed for allocating and policing of access rights for the licensed level of usage of the people accessing the courseware.

> E.g. tutors will need access to incorporate learning objects or entire courses into their programmes. Authorised students will need access to download and use the course material, while administrators will all need another different level and type of access to ensure that royalties are paid. .

5.7 Financial and administrative accountability

Standards will be necessary to track and account for usage of the courseware. This may include standards for interfaces with student administration systems and with financial packages to generate the appropriate royalty payments.

6. Learning objects

Central to any discussion of interoperability standards is the concept of learning objects. The learning object model stands to transform the creation and distribution of e-Learning content and the importance of standards cannot fully be appreciated without an understanding of the learning object paradigm.

Providing a definition of learning object is a contentious undertaking. For the purposes of this document David Wiley's (2000) definition; "any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning" is used.

Learning objects have often been likened in early literature to Lego™. Learning objects or small units of learning, like Lego™ can be snapped together to form larger units of learning or re-used in other structures. While it is useful, like all metaphors, it has its limitations and these are discussed elsewhere (Wiley, 2000).

The Lego metaphor has application when discussing standards. Any Lego™ block can be snapped together with any other Lego™ block regardless of its size, shape or colour. In the same way, complying with standards ensures learning objects that are developed have maximum flexibility.

Four examples of methods for describing Learning objects are as follows:

6.1 Integrated model

A conceptual standard was described as an integrated multi-layered model in the original e-Learnz feasibility report[1] e.g.:

Layer	Description	Specification
1	Instructional design utilising existing pedagogical standards	None
2	Formative assessment	IMS QTI
3	Content presentation media	IMS Content Packaging
4	Technological support for the media including interoperability standards	IMS/IEEE LOM
5	Communications technology (i.e. delivery) including interoperability standards	AICC API Communication

Abbreviation		Full Name	Examples
LOM	-	learning object metadata	IMS Meta-Data v1.2.2 and IEEE 1485.12.1-2002
API	-	Applications programming interface	Generation 21, see 6.2.

The original feasibility report commented that a set of overarching guidelines will be necessary to ensure the quality of compiled courses including such things as student support. The dynamics of pedagogical standards are such that discussions on this topic have been specifically excluded from this document. Approaches to student management however, are being addressed from a variety of standpoints. Examples include simplifying searching for material e.g. JISC Information Environment architecture (see 6.5) and LAMS (see 6.3) for collaborative activity and sequencing delivery for individual student needs.

6.2 Competencies and learning objects

Generation 21's Learning Content Management System (LCMS), Total Knowledge Management[2] (TKM), falls into the prescriptive learning object category TKM does allow some flexibility in design and delivery.

TKM specifies a content hierarchy, in which smaller content assets are combined into larger ones as you move from the bottom up. "A learning object is not just a small piece of content," says director of systems engineering Rich Sutton. "It can be a course, a module, a unit of instruction, or a competency, which is a skill or knowledge for a task."

[1] Online Learning Knowledge Centre Feasibility Study A. Grant and C. Gibson 14/12/01

[2] Learning Objects of Desire, Promise and Practicality: Lori Mortimer American Society for Training & Development April 2002.

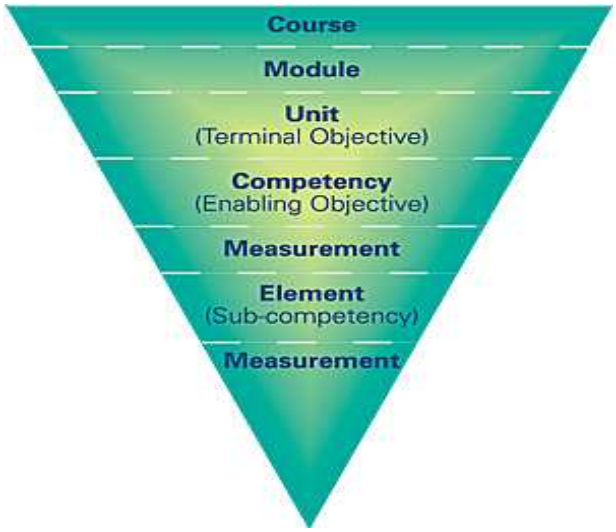


Figure 4 TKM Hierarchy

Each TKM hierarchy level can be considered a learning object. That is because TKM can deliver any level individually, down to a single media object, such as a graphic or sound file. From an instructional standpoint, however, TKM considers the dynamic learning object at the competency level.

Within the hierarchy, a competency "should be measurable and have an objective associated with it," says Sutton. "The idea behind the system is to make those competencies digestible pieces of information. A competency could be a [step-by-step] procedure for how to change a tire, or [general] knowledge about how to change a tire"

In addition, even though the TKM learning object hierarchy is fixed, the system offers some adaptive delivery capabilities. Based on measurement items delivered during the learning experience, the system tracks how quickly each learner absorbs new information and skills. The system then dynamically modifies how and in what sequence it presents the learning object content to each learner.

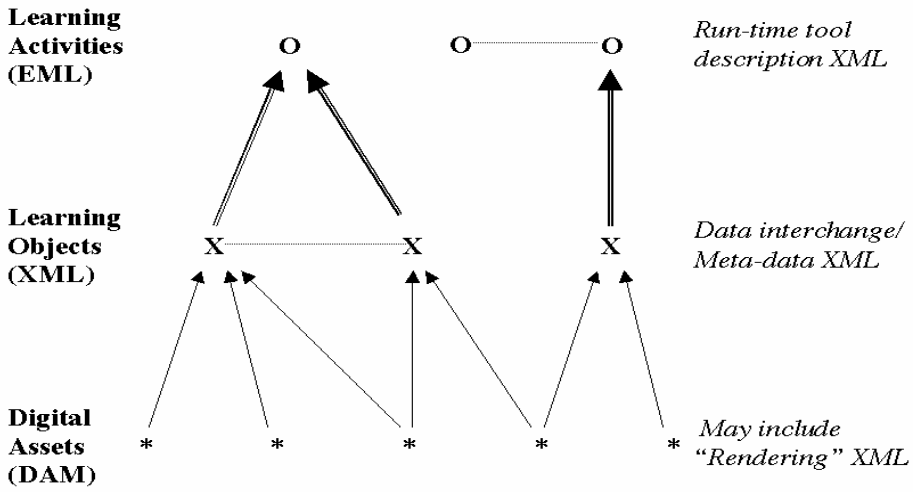
6.3 Dalziel Model

James Dalziel is Executive Director of WebMCQ Pty Ltd and Senior Lecturer, Institute for Teaching and Learning, University of Sydney and a central participator in the Collaborative Online Learning and Information Systems (COLIS) program.

Dalziel defines a Learning Object is an aggregation of one or more digital assets, incorporating meta-data, which represent an educationally meaningful stand-alone unit (Dalziel, 2002)

This three-tiered structure is represented in the diagram below. It illustrates the fact that several Digital Assets may be combined to form a Learning Object (as well as re-used in other Learning Objects), and that one or more Learning Objects may be used for a Learning Activity. In addition, two (or more) Learning Objects may be chained together to create a "Learning Object Sequence", as can two (or more) Learning Activities, to create a "Learning Activity Sequence" (see the horizontal dotted lines). The central advantage of this approach is that it allows for greater clarity in specifying the different elements of re-usability in e-learning, and gives the term "Learning Objects" a more narrowly focussed (and hence hopefully more useful) meaning.

Figure 5 the Dalziel Model



LAMS stands for "Learning Activity Management System". It is an e-learning approach based on collaborative learning environments where groups of learners work together to achieve educational outcomes set by a teacher. Collaborative tasks can include asynchronous discussion boards, live chat, web page sharing, file sharing, assessment tasks, group ranking, etc. Learners can work together as a whole class, in subgroups within the class (and then report back to the whole class), or as individuals. Included in the functionality of LAMS is the matter of sequencing delivery as a design feature and the adjustment of sequencing tailored to meet individual student needs.

6.4 The Le@rning Federation model

The Le@rning Federation is an initiative of State and Federal governments in Australia and (it is claimed) New Zealand. Over the period 2001-2006 the Initiative aims to develop online interactive curriculum content specifically for Australian and New Zealand schools. The Initiative will support teachers in enhancing student learning.

The information model for learning objects is illustrated in Figure 3-1: Learning Object Information Model. Learning objects contain resources, organisations, and metadata.

Resources are files and sub-ordinate learning objects that are used to facilitate the learning experiences. Resources can be any of a number of file types, such as XHTML files, CSS style sheets, Flash interactive files, mp3 audio files and so on.

An organisation specifies a navigation path through the learning object. A learning object may have many organisations, and hence many possible navigation paths. For example, a learning object may have two educationally equivalent organizations: one optimised for visual learners, and one optimised for use by visually impaired learners.

Within a learning object, metadata is structured information about the learning object and its resources. For example, metadata may include the learning object's title, description and educational purpose. Learning Federation metadata is described in The Le@rning Federation Metadata Application Profile. It supports learning object and resource management, description of educational purpose, technical interoperability, digital rights management and accessibility.

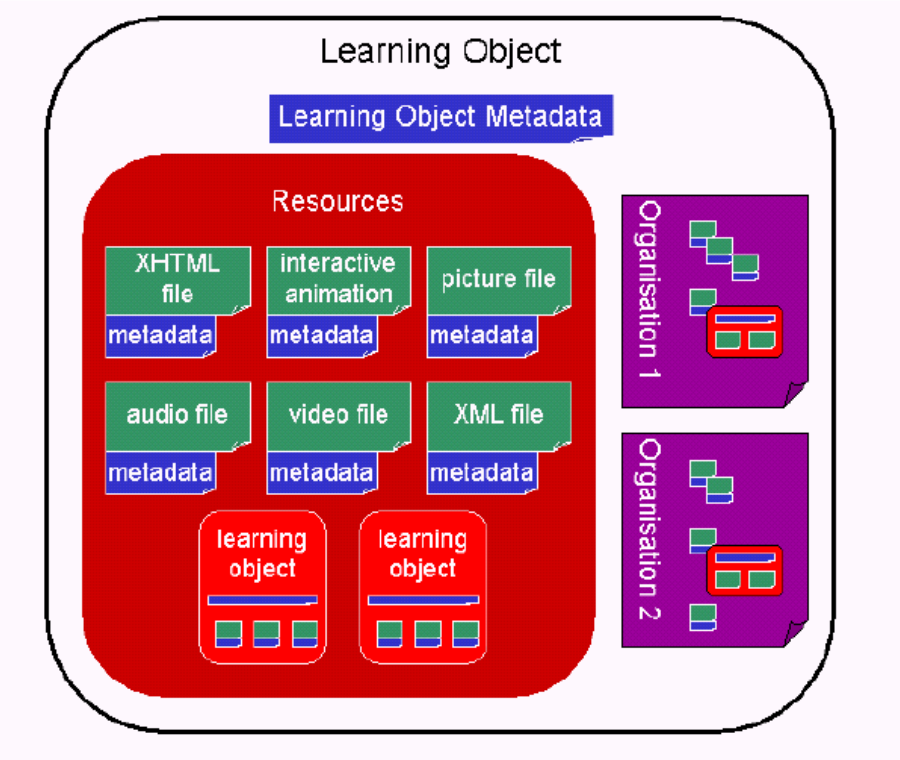


Figure 6: The Le@rning Federation LEARNING OBJECT INFORMATION MODEL

6.5 JISC and UKOLN

The Joint Information Systems Committee (JISC) works with further and higher education by providing strategic guidance, advice and opportunities to use ICT to support teaching, learning, research and administration. JISC operates through a committee system whose membership consists of senior managers, academics and technology experts working in UK further and higher education. Funding for the JISC comes from a variety of UK Government, further and higher education funding councils. The JISC is supported by United Kingdom Office for Library Networking (UKOLN) a “centre of expertise for digital information management.

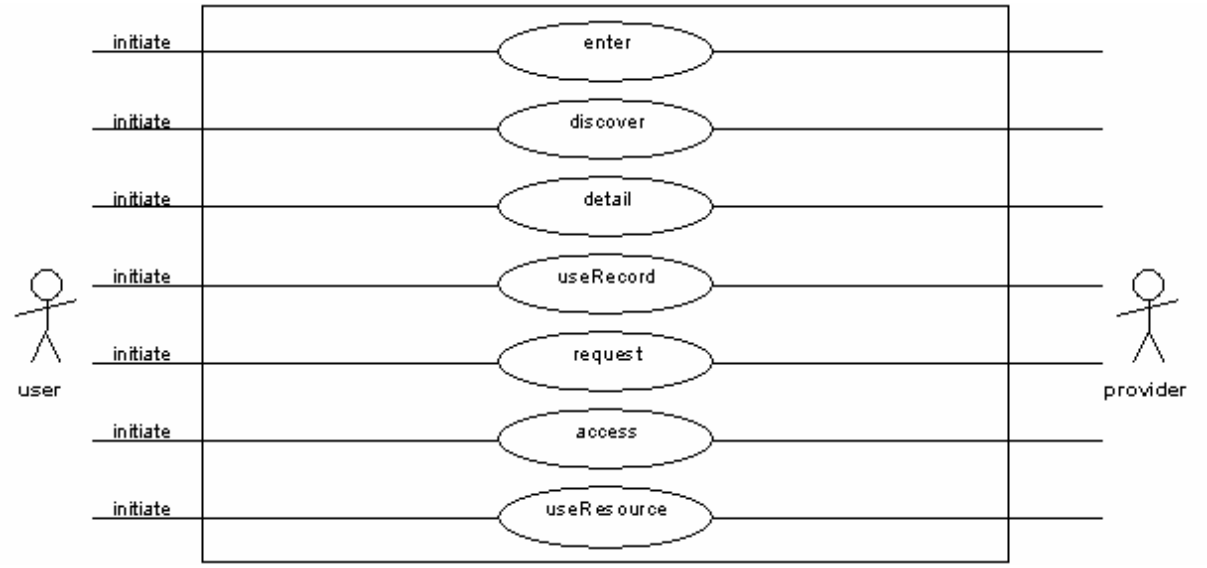
The JISC Information Environment (JISC IE) is described as a 'system' with which the end-user can interact. There is however, no intention that the JISC IE be seen as a single system or service. The functionality described may be offered by lots of different services and, in the general case, the desired functionality will only be available by combining several different JISC IE service components including the browser on the desktop, content provider services, institutional portals, subject gateways and local virtual learning environments. No attempt is made to map functionality to particular systems or services.

A high-level view of the JISC IE functional model shows the distributed service components that need to be offered in order to support the desired functionality. However, JISC IE modelling provides a view of the components in context and identifies gaps in current provision.

Basic use cases

The approach is based on “use cases”. The use cases are based on those developed for the MODELS Information Architecture (MIA) [3]. The four MODELS verbs - discover, locate, request, deliver - are taken as the starting point. These are the basic processes through which an end-user must move from having identified a need to obtaining a resource that they can use.

This is very a very generic model and is equally applicable to buying a car as it is to obtaining learning resources or research material online. We have modified and extended this basic model in a number of ways.



The 'locate' and 'deliver' use cases replaced with more generic 'detail' and 'access' use cases. We have also added a number of additional high-level use cases - in particular, 'useRecord' and 'useResource'. These actions show the end-user actually doing something with the resources they obtain. To read more see http://www.ukoln.ac.uk/distributed-systems/jisc-ie/arch/functional-model/

7. Tools

Funded by the JISC, Reload aims to develop a suite of software tools for authoring learning objects. The Reload suite (www.reload.ac.uk) consists of a cross-platform open source content package editor and player. It supports the IMS content packaging and metadata specifications and produces SCORM compliant content packages that can be run with a SCORM compliant LMS or the Reload SCORM player. The Reload SCORM runtime environment, is essentially a barebones LMS, also allows content developers to inspect the API communication flow between the browser and the LMS.

8. Current interoperability standards (options)

Determining the current position of standards for interoperability has been assisted by the work done by The Centre for Educational Technology Interoperability Standards (CETIS) see < http://cetis.ac.uk/static/who-does-what.html >.

8.1 Who is involved in standards?

The following relates specification and standard setting bodies with the areas in which they are involved.

Area	IMS	Dublin Core	IEEE Learning Technology	AICC
Communication Interface				✓
Metadata	✓	✓	✓	
Content	✓		✓	✓
Enterprise	✓		✓	
Learner Information	✓		✓	
Question & Test	✓			
Accessibility	✓			
Learning Design	✓		✓	
Collaboration	†			
User requirements	‡			

Competency	✓		✓	
Digital Repositories	✓		✓	
Sequencing			✓	

† Among future concerns
‡ No longer supported

Abbreviation		Organisation	Role / Characteristics
DCMI	-	Dublin Core Metadata Initiative	Promoter and developer of (metadata) standards

8.2 Scope

This document addresses the three main specification areas which have been implemented by reference models. The three areas are:

1. Communication Interface-how learning objects communicate information about the learner, such as the learner's name and test scores, with Learning Management Systems (LMS). The Airline Industry CBT Committee (AICC) developed a specification to enable interoperability which was subsequently widely adopted outside the airline industry. AICC's CMI (Computer Managed Instruction) Guidelines for Interoperability describe:

   - a set of data elements containing both core and optional elements
   - and two protocols:
     - HACP (Hypertext AICC Communication Protocol)
     - Application Programming Interface (API).

   for communication between the learning object and LMS.

   LMS vendors are standardising on the AICC API communication protocol, often referred to as the "API communication" specification. It is a set of ECMA Script (JavaScript) functions for accessing LMS services and has recently been accepted, with minor modifications, as a formal standard (IEEE 1484.11.2).

2. Learning Management System (LMS) vendors have standardized on the Airline Industry CBT Committee (AICC) API communication specification Metadata—how to describe e-Learning resources in a consistent manner to enable learners and course-authors to locate and identify these.

   There are two widely used, complementary, metadata standards: the IMS/IEEE Learning Object Metadata (LOM) and Dublin-Core Metadata Initiative (DCMI). The LOM is focused on describing educationally purposed learning objects where as DCMI is wider in its scope and is used to describe non-educational resources. Of course, the distinction is often not clear. The two standards are not competitive solutions; they are synergistic and interoperable as the LOM can be mapped to DCMI. Other standards have evolved to meet specific requirements. For example, the Education Network Australia (EdNA) metadata standard, defined for the Australian educational context is based on, and interoperable with, both DC and the LOM.

Metadata standards

Standard	Support Organisation(s)	Characteristics
Dublin-Core Metadata Initiative	A international collaboration of Universities, National Libraries and Standards organisations.	International participation and acknowledgements including: The Internet Engineering Task Force (IETF) http://www.ietf.org/ The European Committee for Standardization (CEN) http://www.cenorm.be/ The National Information Standards Organization (NISO) http://www.niso.org/ The International Standards Organization (ISO) http://www.iso.ch/
IMS/IEEE Learning Object Metadata	Institute of Electrical and Electronic Engineers	Education focussed and interoperable with the DCMI
JISC IE	Supported by UK government, further and higher education	Provides context for the discussion of metadata.

	funding councils and supported by United Kingdom Office for Library Networking (UKOLN)	
Education Network Australia (EdNA)	Australian education institutions.	Interoperable with, both DC and the LOM

3. Packaging—how to gather learning resources into useful bundles.

   Instructional Management System Standards (IMS) Content Packaging is the most widely implemented specification, which describes an XML file divided by:

   - Metadata—information describing the course (implemented using the IMS/IEEE LOM specification)
   - Table of Contents—the order of resources used in the course.
   - Resources—a "packing list" of all the resources needed to deploy the course.

   The resulting XML file is known as a "manifest".

8.3 Current options

Current practice has seen the adoption of two reference models (a unified collection of specifications and/or standards):

ADL SCORM™

Shareable Courseware Object Reference Model (SCORM) is a content interoperability standards project of the Advanced Distributed Learning (ADL) organization within the United States Department of Defence. SCORM represents one of the best examples of the application and integration of e-Learning standards. Outside the defence sector, SCORM is being adopted by a number of training and education vendors. Version 1.2 of SCORM combines the IMS/IEEE Metadata and Content Packaging specifications and the deployment, tracking and launching capabilities of the AICC API Communication specification.

The Australian SOCCI Project (Schools Online Curriculum Content Initiative) <http://www.thelearningfederation.edu.au/tlf/> offers a guiding example of the use of standards in the development of learning objects. They have implemented the SCORM to ensure the interoperability of learning objects.

Microsoft LRN

The Learning Resource iNterchange (LRN), (pronounced "learn") is Microsoft's reference implementation of the IMS Content Packaging and metadata specifications. As such LRN is also compliant with the SCORM. Microsoft provides a toolkit with the tools required to assemble LRN compliant content.

The focus on LRN follows from the fact that widely used tools such as Microsoft PowerPoint and FrontPage and Macromedia Dreamweaver export IMS content packages that conform to the LRN reference implementation.

8.4 Compatibility

The following table illustrates the compliance of these two reference models with the three key standards areas.

	Specification / Standard	SCORM	LRN
Communication Interface	AICC API Communication	✓	
Metadata	IMS/IEEE Learning Object Metadata (LOM)	✓	✓
Packaging	IMS Content Packaging (CP)	✓	✓
	AICC Course Structure File (CSF)	✓	✓

8.5 Product compliance

Standards are of little use if nobody complies with them. Unfortunately, the issue of compliance is not black and white. The following is a brief discussion about the standards compliance of the most recent versions of the two most common LMSs used by the New Zealand tertiary education sector.

WebCT

The WebCT family consists of two different platforms, Vista, which is fully SCORM compliant and Campus Edition which does not fully implement the SCORM reference model.

With the 4.0 release of Campus Edition, WebCT added a utility for the import of learning objects in its own proprietary format, and the Microsoft LRN implementation of IMS Content Packaging. The most recent version (at the time of writing), Campus Edition 4.1 integrates the import utility and adds better support for some non-LRN, IMS Content Packaging compliant objects.

Because WebCT exports IMS content packages with proprietary extensions they are unlikely to work with IMS compliant content packaging tools from other vendors. These exported packages are also not LRN compliant.

Blackboard

As of version 5 Blackboard is SCORM compliant via its extensible building block architecture. Version 6 adds native SCORM compliance.

Moodle

Moodle is an open source LMS developed from a constructivist education position. The current version (1.1) is not SCORM compliant. Basic compliancy is slated for release in the middle of 2004.

9. Other Specifications

Simple Sequencing <http://www.imsglobal.org/simplesequencing/index.cfm>

IMS Simple Sequencing is a specification used to describe multiple navigation paths through a collection of learning activities. It is simple only because it restricts itself to the case of a single user in the role of learner and to a limited number of ways to control sequencing. More complex cases of multiple learners and roles are addressed by the Learning and Design specification.

Simple Sequencing is to be adopted by the forthcoming SCORM 1.3 reference model and will go some way to addressing its pedagogical inadequacies.

Question and Test Interoperability <http://www.imsglobal.org/question/index.html>

The IMS Question and Test Interoperability (QTI) specification provides an extensible XML language for sharing test or assessment items between LMSs. The specification describes three key data structures:

1. Assessment – the basic test unit;
2. Section – a container for groups of sections and items which support a common objective;
3. Item – the fundamental self-contained question/response block within which the individual questions are contained.

The principal aim of the specification is to allow users to import and export their question (termed Items and grouped in Sections) and test (termed Assessments and containing Sections) materials (IMS, 2003a). The specification is implemented in a growing number of applications, for example Respondus http://www.respondus.com/.

Learning and Design <http://www.imsglobal.org/learningdesign/index.cfm>

The IMS Learning and Design specification has its antecedents in the Open University of the Netherlands' Educational Modelling Language (EML) specification. It is designed to support reuse and to interoperate with

other IMS specifications (for example, assessments notated using the QTI specification could be referenced by a learning design).

Rather than prescribing one or more pedagogies the specification describes a generic XML-based language that can be used to express pedagogy. While there is no assured path, if adopted by the ADL, the IMS Learning and Design specification would go along way to addressing the pedagogical inadequacies of the SCORM.

The specification uses the familiar metaphor of teaching and learning as a Play with Acts and Role-parts in each Act (IMS, 2003b). Teachers and learners take on Roles and interact not only with content, resources and other Acts, but also with each other.

Although there are no current implementations of this specification, the Learning Activity Management System (LAMS) (Dalziel, 2003) is "inspired" by the specification.

10. Conclusion and recommendations

It should be noted that standards compliance is not a complete solution for e-Learning collaborative practice. The immaturity of e-Learning standards means that they are in a constant state of flux with new versions of standards being released regularly, often compromising compatibility with older versions. Moreover, this dynamic environment has led to different interpretations of standards with vendors often only implementing a subset of standards.

With the SCORM positioned as the "de facto" reference model and in the absence of any other comprehensive solution an awareness of the SCORM's limitations is prudent. The SCORM's strength is in interoperability and reusability; as a vertical industry implementation of the IMS and AICC specifications it has limitations when applied more broadly. Specifically, the SCORM aims to be pedagogically neutral and makes no allowance for collaborative or student-centred learning, instead its focus has been on a simple linear sequence of learning activities. Because of this, there is some debate as to the suitability of the SCORM for higher education applications. However, at this time it would be hard to see individual institutions or collaborations adopting interoperability standards other than those of the SCORM. The significance of this reference model is revealed by the United States federal government's statement that SCORM compliance is a prerequisite for eLearning contracts (Brennan *et al.*, 2001).

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Microsoft LRN (on-line) Tool kit	http://www.microsoft.com/elearn/support.asp
Learnativity.com	http://www.learnativity.com/standresources.html
Centre for Educational Technology Interoperability Standards (CETIS)	http://cetis.ac.uk/static/who-does-what.html
UKOLN	http://www.ukoln.ac.uk/metadata/
JISC IE	http://www.jisc.ac.uk/