Australian Flexible Learning Framework

Supporting Flexible Learning Opportunities

Final Report and Recommendations

VET Learning Object Repository Project

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An initiative within the Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004

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Contents

Executive Summary

This paper represents the findings from the VET Learning Objects Repository project in 2003. The project was established with the aim of demystifying learning objects and to inform the future development of interoperable resource repositories facilitating access, sharing and transfer of learning objects based on compatible standards within the VET sector.

The project recognises that achievement of this goal would be significantly advanced by the adoption across the sector of a common standard and the development of appropriate specifications.

The project identified three major areas of particular importance: content packaging, metadata and the specifications to support repository interoperability.

Content packaging is the structured packaging of raw content and resources in a standard manner to facilitate discovery and interoperability within a digital environment. This requires:

- a standard and flexible metadata application profile
- a standard way to aggregate multiple resources of various types
- a standard way to express structural relationships within the resource collection.

A standardised content packaging specification should be adopted for VET learning objects and repositories that would meet these requirements.

Metadata is essentially data about data. There are currently a number of metadata standards available and from this a number of metadata application profiles have been developed and are in use in the Australian VET sector. A metadata application profile is an assemblage of metadata elements selected from one or more standards, structured in such a way that it is able to meet the functional requirements of a particular organisation or community, while retaining interoperability with the original standards.

A common metadata application profile is seen as critical for enabling resource discovery through repositories.

Digital Repository Specifications in the context of this project refer to the technical specifications that need to be implemented by developers of both repositories and learning resources to facilitate the development, discovery and re-use of learning resources.

Several specifications are currently in existence, and others are under development, but there is yet to be a national approach to the further development or acceptance of these specifications.

The project also recommends focusing on the current work being done with standards and interoperability and to look to the various Framework projects and trials in this area to inform the ongoing research and development of both learning objects and associated repositories.

Summary of recommendations

Content packaging

R.1 A standardised content packaging format should be adopted for VET learning objects and repositories participating in the national system, which:

- is based on existing IMS content packaging specifications
- is informed by ongoing trials currently being conducted by the Framework.

Metadata

R.2 A national Metadata Application Profile should be developed, which:

- is based on international standards
- supports metadata encoded using XML
- is scalable to suit individual organisational requirements
- incorporates appropriate vocabulary guidelines
- facilitates Digital Rights Management (DRM) through the use of an appropriate Rights Expression Language (REL)
- supports mapping to existing metadata standards (i.e. EdNA)
- is informed by other Framework projects.

Repository specifications

R.3 A national set of technical specifications should be developed for object repositories within the VET sector. These specifications should:

- be based on and support the IMS Digital Repository Interoperability Specifications
- ensure the interoperability of VET sector resource repositories, recognising that state and territory jurisdictions operate across various platform/vendor technologies
- support existing standards such as SCORM and IMS content packaging
- be informed by the 2004 VET Learning Objects Repository Implementation project.

Background

The VET Learning Object Repository Project 2003 was established as part of the Resources for Teaching, Learning and Assessment program (RTLA) under the Australian Flexible Learning Framework (Framework). The primary aim of the project was to identify the current state of play with regard to learning objects, bringing together multiple perspectives, diverse opinions and experiences associated with the learning object paradigm.

To achieve this, the project considered learning objects from a number of perspectives including:

- **Learning design:** the differentiation of learning and content objects; levels of granularity, components of a learning object; types of learning objects; and the central issue of accommodating the specialised nature of the VET sector, particularly with regard to the high level of contextualisation required for this environment
- **Technical and implementation issues**: such as architecture; interoperability of learning objects; contextualisation; and communication with LMS
- **Legal:** digital rights in making access available
- **Access and distribution:** consideration was given to learning object discovery; and catering for systemic and local distribution needs.

Deliverables

The major deliverables of the VET Learning Object Repository Project are a suite of papers designed to both inform and guide the development of learning objects and learning object repositories within the VET sector as follows:

Vet Learning Objects Repository Green Paper.

Summary of consultation

A suite of research papers:

- Potential Benefits and Challenges in the use of SCORM in VET
- Learning object repositories issues for VET sector organisations
- Using metadata for online learning resources
- Introduction to Standards and Specifications for Learning Objects and Repositories.

VET Learning Objects Repository final report and recommendations

Introduction

Training facilitators traditionally use a range of resources in their work including student handouts, overhead transparencies and photographic slides. More recently, a plethora of digital resources have been created and there is a growing need for cataloguing, storage and retrieval systems that will allow facilitators to access and share these resources.

The development of such systems requires standardisation in the development of resources (learning objects), cataloguing (metadata) and storage facilities (repositories).

This summary outlines the main issues that must be considered when implementing a learning object approach to content development and delivery in the VET sector. It also provides recommendations for approaching these issues. The main issues covered include:

- learning objects
- metadata
- content packaging
- learning object repositories
- standards.

Learning Objects

The term *Learning Object* has been defined in a number of different ways by various individuals, organisations and standards bodies. In their Flexible Learning Leader 2002 Report, Higgs, Meredith and Hand state that there is anxiety amongst people in the VET sector over the lack of a clear definition of the term ‘learning object’.

One of the more widely accepted definitions of a learning object is that provided by the International Electrical and Electronic Engineering Associations (IEEE) Learning Technology Standards Committee (LTSC) as:

> *‘any entity, digital or non-digital, which can be used, re-used or referenced during technology-supported learning’.*

While this definition is an adequate starting point, it does suggest that a *learning object* should be a self-contained resource that meets a specific learning objective.

In the VET sector, there is a wide range of resources that can be shared and repurposed (re-usable objects). Self-contained resources that address a specific learning objective are a small component of the many re-usable objects in the VET sector.

As the VET Learning Objects Repository Green Paper noted, it may well be that a common definition for learning objects is inappropriate. As Higgs et al (2003) have pointed out, ‘One of the weaknesses with many learning object implementations has been the concentrated effort on learning objects themselves rather than the systems they inhabit or need to play out in’.

The reason for this lack of a common definition stems from the fact that learning objects need to come in a vast variety of shapes and formats. Think of learning objects as you would any educational resource. They range in diversity from a

chapter in a book, to points and visuals on an overhead transparency or PowerPoint slide, and can be applied to a range of purposes, in a range of settings by designers, managers, trainers, content writers and learners. With this breadth of diversity, it is easy to see the difficulty in providing an exact definition that encompasses the full range of educational resources. Likewise, learning objects have a similar range of diversity.

As Higgs et al note, it may be more productive then if we simply consider what are commonly considered to be essential characteristics of a Learning Object. In consultation with a range of VET practitioners, managers and content developers, the VET Learning Objects Repository Project has identified the following five characteristics as being essential to learning objects within the VET sector.

Discoverable
In order for a learning object to be usable it needs to be discoverable. For this reason, all resources contain (or are associated with) metadata. Metadata is information about information. Like index cards in a library, metadata records will help people find and maintain learning objects.

While metadata can provide a lot of information about a learning object, at a minimum it should provide a brief description of the object as well as providing other important information such as subject, resource type, publisher and date created.

Interoperable

Interoperability is about being able to share objects across repositories, organisations and learning and content management systems. To enable this, interoperability objects should conform to standards in two main areas:

1. *Metadata* - using common standards to describe objects allows computer systems to take a standard approach to searching and displaying the metadata descriptions.
2. *Packaging* - selecting a range of objects from a repository and combining them into a learning sequence where they are all packaged in a standard way allows them to be used in a range of learning management systems. The Shareable Content Object Reference Model (SCORM) is an evolving standard that supports this concept.

Context-able
Context is very important in terms of providing authentic learning within the VET sector. Learning resources should therefore either have an existing level of context (i.e. contextualised) or should be adaptable to a variety of contexts (i.e. context neutral).

There is much debate about the ideal level of context for learning resources, and it is generally accepted that the less context a resource has the more re-usable and adaptable that resource is. It is important to remember therefore that when designing or using learning resources that the appropriate level of context for the target audience is applied.

Editable
An important feature of all learning resources within the VET sector is that they can be retrieved, saved, edited and used. Once edited, a learning resource may take on a considerably different appearance or function. In this

case, it may actually be considered a new resource that can then be re-used by others. Updated metadata will need to be added to the new resource to facilitate discovery.

Re-usable
The ability to be able to re-use existing objects is also important for the VET sector as it means greater access to a wide range of resources and less overhead in developing resources from scratch.

Standards and specifications

There has been substantial movement world-wide to promote interoperability in the e-learning arena by establishing standards and specifications for learning content, and for the associated structures and systems which store and provide access to content for presentation to learners.

There is a current need within the Australian VET sector to develop a network of interoperable resource repositories, with a view to facilitating access, sharing and transfer of learning objects based on compatible standards. Achievement of this goal would be significantly advanced by the adoption across the sector of a common series of specifications for the most relevant functions.

To facilitate this, it is important to distinguish between standards, specifications and the related term “reference model”, which despite their similarities, serve different purposes.

Standards: Standards can only be created by an official standard-setting body. Internationally, the key standards body is the International Organisation for Standardisation (ISO). The ISO’s JTC1 SC36 sub-committee sets information technology standards for learning, education and training.[1]

Standards are also developed by organisations such as the IEEE (International Electrical and Electronic Engineering Association) Learning Technology Standards Committee (LTSC) which ‘is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology.’[2] The Learning Object Metadata (LOM) standard is an example of an important standard developed by the IEEE.

Specifications: Unlike standards, specifications are developed by organisations to define how to structure information such that they can support interoperability (the ability for two different systems to share information and therefore to substitute for one another or to share content and data as part of a unified workflow). For this reason, specifications tend to be quite specific in their requirements and traditionally provide significant detail of how the specifications should be implemented.

In the learning world, many important specifications are being developed by the IMS Global Learning Consortium, Inc. Specifications sometimes mature into standards.

[1] JTC1 SC36 website http://www.jtc1sc36.org/
[2] IEEE LTSC website http://ltsc.ieee.org

Reference Models: Reference models are collections of standards and specifications, often with additional rules that spell out how the different standards and specifications work together. In many cases, reference models are open to interpretation and do not necessarily provide the same level of detail as specifications. The Shareable Content Object Reference Model (SCORM) is an example of a reference model currently in use within the learning industry.

IMS has made a significant contribution to the development of eLearning standards and specifications, most notably for its work on LOM (which has since been endorsed by the IEEE LTSC) and SCORM. More recently, IMS has released the Digital Repositories Interoperability Standard. This is largely a technical document that establishes a range of specifications for the search, retrieval and storage of learning resources within a digital repository.

However, in order to do this, there is a need to create these 'learning objects' in a standard fashion so that they can not only be used and re-used within the learning organisation but also have the potential for use elsewhere. eLearning specifications and standards enable this interoperability: between multiple learning content management systems (LCMS), a variety of learning object repositories (LOR) and end user (Forth, S. & Childs, E., 2003).

SCORM

The Sharable Courseware Object Reference Model (SCORM) was released by the Advanced Distributed Learning Network (ADL) in January 2000.

SCORM is not a standard in itself, but rather a reference model that serves to test the effectiveness and real-life application of a collection of individual specifications and standards to create a "unified content model" to enable the re-use of learning materials across a range of products and platforms (Advanced Distributed Learning 2003). It includes:

- specifications relating to the run-time environment
- specifications for representing course structures or content aggregation
- specifications for creating metadata records for courses, content, and raw media elements.

The Runtime Environment specifies how the content should behave once it has been launched by the LMS. A SCORM compliant LMS is required to implement an API (Application Program Interface) consisting of eight functions that content may access to communicate with the LMS (Advanced Distributed Learning 2003).

SCORM uses the IMS Content Packaging Specification developed by the IMS Global Learning Consortium. The content packaging specification defines how training should be packaged digitally to facilitate sharing learning resources. A standardised manifest file describes their structures and makes their manipulation easy.

The SCORM Metadata Application Profile directly references the IEEE Learning Object Metadata (LOM) standard and the IEEE Draft Standard for Extensible Markup Language (XML) Binding for Learning Object Metadata Data Model. The metadata specification defines a very rich data model of approximately 64 metadata elements:

however, only a small subset of the data elements is required to achieve SCORM compliance.

SCORM is proving to be a popular choice for many e-learning organisations and offers the following advantages:

International acceptance. SCORM is backed by the Advanced Distributed Learning Network (ADL) and has strong support of both IMS and the International Electrical and Electronic Engineering Associations (IEEE) who are committed to ensuring its ongoing evolution and support. SCORM has become the defacto standard for several of the major LMS developers.

Interoperability across systems. SCORM-compliant content can be used on any SCORM compliant learning management system. This means that content from many different sources can be used on any SCORM compliant LMS.

While these two advantages are a source of significant attraction to the VET sector, there is also debate in academic circles as to SCORM's ability to meet a student's learning needs, particularly in regard to pedagogy and context.

This is centered on the claim that SCORM is 'pedagogically neutral'; in addition, individual SCOs (Shareable Content Objects) by themselves should be as independent of learning context as possible so that they may be re-used in different learning experiences to fulfil different learning objectives. This is of particular concern to the VET sector, in which the combination of context and pedagogy are often seen as integral to a meaningful educational experience. Attempts to remove context to enable greater re-usability or SCORM compliance may damage the vast connections learners make from a realistic example or a concept placed in context.

As SCORM uses System Directed Learning it is intended for, and assumes, implementation and management within an LMS. As such individual SCOs do not contain internal navigation systems and require third party software to supply this level of functionality. However, because the SCORM standard is open to interpretation, packages that work one way in one LMS are not guaranteed to necessarily work the same in other LMSs. This could mean that packages will need to be tailored to suit specific LMSs.

It is, however, early days for SCORM. Ongoing research and pragmatic testing and experimentation may be able to overcome some of these contentious issues.

Content Packaging

Content packaging refers to the packaging of learning objects such as an individual course or a collection of courses into interoperable, distributable packages. Content packaging provides a standardised way to exchange learning objects between different systems or tools. Learning objects described and packaged using a content packaging specification should be interoperable within LMSs that support the same specification.

In response to the need for content packaging specifications, several organisations have developed specifications. The AICC Course Structure File (CSF) file format provides advanced capabilities for representing lesson prerequisites, however, the implementation requires a group of files organised as both Windows' INI files (or similar) and comma-separated value (CSV) data files.

The IMS Content Packaging provides a common framework for the packaging and description of learning material. The specification is aimed at both content developers and learning management system vendors. The IMS specification defines a package as a chunk of re-usable content. It is represented in the form of an XML manifest file with the predefined name *imsmanifest.xml*.

Content packaged in XML format in accordance with the specification could be distributed on a range of compliant LMSs.

Overall, the IMS Content Packaging Specification has received wide acceptance and has become something of the defacto standard for most LMSs. It is also an important part of SCORM.

R.1 A standardised content packaging format should be adopted for VET learning objects and repositories participating in the national system, which:

- **is based on existing IMS content packaging specifications**
- **is informed by ongoing trials currently being conducted by the Framework.**

Metadata

No discussion on learning objects would be complete without at least an introduction to the role of metadata. As Higgs et al (2003) note, ‘Metadata tagging has come to be one of the central aspects of any learning object based approach’.

Simply defined, metadata is the data that describes things. It is ‘meta’ because it applies to anything we want to reference, point to, locate, or re-use. In the learning objects world, metadata is not only essential to aiding the discovery and use of resources, it also has the potential to facilitate resource maintenance and management.

With the vast array of learning resources available through sources such as the Internet, there is a greater emphasis for users to be able to find and use ‘just the right’ content, hence it is important for metadata to accurately describe content in an appropriate and standardised way. Without metadata, inefficiencies result with lots of time and effort spent looking for the right content for the right purposes.

Metadata can, and ideally needs to be, applied to all sizes and types of content and resources used for learning, from the smallest piece of raw data, or asset, all the way up to a complete course or curriculum. Using metadata this way allows each level of content to be easily searchable and re-usable. For example, it is just as easy to find and re-use one piece of text or illustration, one page in a chapter, one chapter of a course, or an entire course.

There are several metadata standards currently in existence. These standards have been developed by national or international organisations in consultation with users and industry groups. The standards are important because they create consistency and enhance interoperability. The main standards relevant to learning objects in the VET sector are:

1. Dublin Core (DC)
2. EdNA Metadata Standard

3. IEEE Learning Object Metadata (LOM) Standard.

The EdNA standard is currently in wide use in Australian education and is quite adequate for most VET applications, Dublin Core is excellent for administrative metadata, while the LOM standard is useful for describing educational attributes and is the standard required for SCORM compliance.

While it is clearly desirable for all organisations within the VET sector to adopt and use one of the existing metadata standards for resource discovery and management, many organisations may find that the existing standards do not meet their needs in terms of resource management. For example, the IEEE LOM Standard provides roughly 64 metadata elements – more than would be practical for everyday use (Fisher S., Tozer, L., Friesen, N. & Roberts, A., 2002).

Fortunately, it is not necessary to adopt and adhere to one and only one metadata standard. In many cases, it is more appropriate to develop a Metadata Application Profile.

Metadata Application Profiles

A Metadata Application Profile is a template outlining the metadata elements that are to be used to describe an organisation's resources. It can consist of elements from one or more standards and custom elements tailored to the functional requirements of a particular organisation or community, while retaining interoperability with the original base schemas. Part of such an adaptation may include the elaboration of local metadata elements that have importance in a given community or organisation, but which are not expected to be important in a wider context.

One of the benefits of this approach is that communities of practice are able to focus on standardising community-specific metadata in ways that can be preserved in larger metadata architectures. It will be possible to snap together such community-specific modules to form more complex metadata structures that will conform to the standards of the community while preserving cross-community interoperability.

Metadata and copyright

The Copyright Amendment (Digital Agenda) Act 2000 came into operation across Australia in 2001. The introduction of the Digital Agenda also raised the issue of Digital Rights Management or DRM. The DRM process involves the recording, transmitting, interpreting and the enforcing of digital rights. Essentially, the management of digital rights aims to:

- protect the legal rights of copyright
- ensure moral rights are protected
- allow reasonable access to copyright materials
- track and record usage of materials.

Considerable investment is already being made by many VET sector organisations to develop learning objects. However, as Hand T., Higgs P. E., Higgs P. L., Ianella, Macnamara, Mason and Meredith (2003) note, 'many of these producers have not considered how these learning objects might be used outside their own organisations or at best, within State systems. Subsequently, they receive very little recognition or benefit from them'.

Several metadata schemas have been developed specifically for describing digital rights information. The Rights section of the IEEE LOM metadata standard provides the following basic elements:

<rights>
<cost>
<copyrightandotherrestrictions>
<description>
</rights>

Such metadata, however, cannot deal with the more complex rights such as the acquisition, creation, distribution, transfer and constraints associated with the active sharing and re-use of learning objects. This has resulted in the emergence and use of Rights Expression Languages (RELs).

RELs are capable of setting the permissions associated with a learning object and the conditions and obligations that need to be followed in order for these permissions to be exercised. However, it needs to be stressed that 'a rights expression language can neither resolve legal questions nor create a policy for collecting fees' (IEEE 2003).

R.2 A national Metadata Application Profile should be developed, which:

- **is based on international standards**
- **supports metadata encoded using XML**
- **is scalable to suit individual organisational requirements**
- **incorporates appropriate vocabulary guidelines**
- **facilitates Digital Rights Management (DRM) through the use of an appropriate Rights Expression Language (REL)**
- **supports mapping to existing metadata standards (i.e. EdNA)**
- **is informed by other Framework projects.**

Repositories

It is generally accepted in the literature that to make the best use of learning objects, they need to be stored in some sort of database or repository. The essential functionality of the repository therefore is to store, retrieve and maintain learning objects.

From their recent research, Higgs et al (2003) suggest that in order to provide access to learning objects, a repository must have the following functionality:

- **search/find** – the ability to locate an appropriate learning object. This can include the ability to browse
- **quality control** – a system that ensures learning objects meet technical, educational and metadata requirements
- **request** – a learning object that has been located
- **maintain** – implement appropriate version control
- **retrieve** – receive an object that has been requested
- **submit** – provide an object to a repository for storage
- **store** – place a submitted object into a data store with unique, registered identifiers that allow it to be located
- **gather (push/pull)** – obtain metadata about objects in other repositories for wider searches and information via a clearing house function

- **publish** – provide metadata to other repositories.

Some VET sector organisations are currently developing and using learning object repositories. Typically, these repositories are stand alone, and are often restricted for use within the organisation.

Within this stand-alone architecture, there is the potential for two major models of repository. The most common suggests a centralised model in which the learning object metadata is located on a single server or website (the learning objects themselves may be located elsewhere). This website or portal then provides the interface with which to search the repository. This model is typical of the smaller intraorganisational repository.

The alternative model is based on a distributed system, in which the learning object metadata is contained in a number of connected servers or websites. Distributed learning object repositories typically employ a peer-to-peer architecture in which a variety of repositories may be searched from a single portal.

An increasing number of commentators (such as Downes 2002) believe that centralised systems are limited and run the risk of becoming closed systems. On the other hand, many of the peer-to-peer systems have their own set of problems including issues of interoperability and digital rights management.

Regardless of the architecture, the value of a well-developed and populated repository cannot be underestimated. However, the costs of developing such a system are often too prohibitive for most institutions.

Nevertheless, the development of a repository is possibly one of the most important undertakings for most educational institutions or at least sectors, in order for it to trade in the emerging knowledge economy.

IMS Digital Repositories Interoperability Specification

The IMS Digital Repositories Interoperability (DRI) Specification was released in January 2003. It provides a set of recommendations to assist interoperability between repositories. The specifications define repositories as collections of assets or metadata that describes assets that are accessible via a network. The specification builds on other relevant specifications such as IMS content packaging and the IMS metadata specification.

The DRI is intended to be an international specification for the development and implementation of interoperable repositories. More specifically, the specifications are geared towards creating collections of resources capable of exposing metadata to resource utilisers for the purpose of searching, gathering, storing, and delivering assets.

The specification addresses how users and tools interact with repositories to input, discover, locate, and deliver learning object metadata and the associated content. It does this by defining a specific set of functions and protocols that enable a diverse range of eLearning systems to communicate with each other.

It is based on established standards such as the Simple Object Access Protocol (SOAP with attachments) and the XQuery XML search language developed by the

World Wide Web Consortium. The specification allows for a wide range of content formats such as may be found in a learning object repository.

The current DRI specification, does not address areas such as digital rights management, verification, e-commerce payment and processing, which are seen as important areas for future development.

R.3 A national set of technical specifications should be developed for object repositories within the VET sector. These specifications should:

- **be based on and support the IMS Digital Repository Interoperability Specifications**
- **ensure the interoperability of VET sector resource repositories, recognising that state and territory jurisdictions operate across various platform/vendor technologies**
- **support existing standards such as SCORM and IMS content packaging**
- **be informed by the 2004 VET Learning Objects Repository Implementation project.**

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Linda Arnold	Resource Generator
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Carol Fripp	AEShareNet
Gerry Green	TAFE Queensland
Tim Hand	Open Training & Education Network
Peter Higgs	TAFE Tasmania
Louise Housden	West Coast College of TAFE
Jill Jamieson	Challenger TAFE
Dennis McNamara	AEShareNet
Kerry Munston	TAFE Queensland
Dan Nicholas	EdNA Online Project
Cath Parker	AITEC
Gary Putland	education.au.edu.au
Simon Sinnot	The Learning Federation
Ralph Wirski	Edith Cowan University

This report has been researched and written by WestOne.

For more information on the Australian Flexible Learning Framework contact:

Framework Communications Team
Phone: (07) 3225 3544
Fax: (07) 3237 0419
Email: aaron.snell@det.qld.gov.au