Australian *Flexible* Learning Framework

Supporting Flexible Learning Opportunities

VET Learning Object Repository

Green Paper for Discussion

flexiblelearning.net.au

An initiative within the Australian Flexible Learning Framework for the National Vocational Education and Training System 2000-2004
Managed by the Flexible Learning Advisory Group on behalf of the Commonwealth, all States and Territories in Conjunction with ANTA

Executive Summary

The purpose of this paper is to seek responses and invite discussion from a range of stakeholders on relevant issues surrounding Learning Object Repositories and the realisable benefits they hold for the VET sector. The release of the paper will be followed up by a series of teleconferences and focus groups designed to debate and further the key points highlighted in the paper.

Much of the debate around learning objects has centered on the need to define what a learning object is. While this has generated a great deal of research and resulted in numerous definitions, it has also created a sense of anxiety and confusion amongst people in the VET sector overall. While the paper provides an overview of learning objects and related issues of metadata and granularity, it is not the intention of this paper to add to the 'What is a learning object?' dialogue, but rather to focus on the demystification of learning objects and to create a better understanding of how they can be used within the VET sector.

The paper considers some of the pedagogical and instructional design issues in relation to learning objects, with a particular focus on the need for context within the VET sector and the role of the teacher in learning. A range of practical issues are also addressed, and the paper invites discussion on several key areas such as the need to provide training for those people using repositories.

Object repositories are also considered in terms of functionality and both distributed and stand-alone repository architectures are discussed. A number of existing repositories are explored both within Australia and overseas. The paper considers what sort of features are particularly desirable within a repository from both the lecturers and the developers view point and explores the issue of what characteristics should be considered when designing and building a repository for the VET sector.

Digital Rights Management (DRM) is rapidly becoming one of the key issues in terms of the management and implementation of learning object repositories. While it is not the intention of this paper to delve into the intricacies of copyright law and legalities of DRM a broad overview of the key issues is presented. The paper also refers to current research being undertaken by the Australian Flexible Learning Framework New Practices project to develop a framework for a rights enabled learning object exchange.

Through the use of repository scenarios different metadata standards are explored and considered in terms of their suitability to the VET sector. The paper considers the need for a standard metadata application profile to be adopted by the VET sector and the minimum metadata requirements. Also considered are a number of metadata management issues such as who should create metadata, metadata administration and the use of vocabularies and thesauri.

The paper looks at the need to establish a set of VET specific guidelines for developing and implementing learning object repositories and considers as a

starting point a range of technical specifications and guidelines, particularly those developed by The Le@rning Federation and ANTA. The key issues for consideration include an examination as to what sort of guidelines should be applied when developing a set of VET specific guidelines for learning object repositories, and how far reaching these guidelines should be.

Throughout the paper we have included specific questions that you may wish to discuss and/or respond to. These questions appear at the end of each of the five main sections of the paper. These questions will be discussed through a series of teleconferences, forums and focus groups and all responses are welcomed as well as any comments or questions you may have.

Contents

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 a standardisation in the development of resources (learning objects), cataloguing (metadata) and storage facilities (repositories). The objective of this paper is to demystify the acronyms and jargon associated with this concept and to provide a blueprint that will enable consistency in the development and use of vocational education and training (VET) learning object repositories.

Background

This paper has been created at the request of the Australian Flexible Learning Framework (Framework). It is a draft document that has been prepared as the result of a consultation process involving lecturers, content developers and managers active within the VET sector.

The paper is intended to facilitate further consultation within the VET sector to define a set of guidelines on the development and use of learning object repositories. Results from this process will be documented in a final white paper that will be widely distributed throughout the VET community.

Scope

This paper looks at considerations for learning object implementations within the context of the Australian VET sector specifically from the viewpoints of Registered Training Organisations, developers and practitioners. The focus is on digital learning objects as opposed to paper-based or non-computer based resources and it builds on existing research and implementations both within the Australian VET sector and the wider education community.

An overview of learning objects

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'. Although several definitions do exist (see Appendix A), there is currently no agreement on what exactly is a learning object. It may well be that a common definition is inappropriate.

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 a distinct set of characteristics that could be used to define educational resources. Likewise, learning objects have a similar range of diversity.

It is the opinion of the authors that attempts to constrain the term learning object to an explicit definition to meet the requirements of the VET sector may be somewhat futile. As can be seen in the examples that follow, the defining characteristics will vary from setting to setting and this multiplicity of profiles affords flexibility. Higgs et al (2003) agree that there is an 'emerging need for acceptance of different types of learning objects'. Similarly, Duncan and Ekmekcioglu, (2003) in Reusing Online Resources, say that there will always be big, little, and personal repositories of mixed types of assets. Acceptance of this openness in definition, while unnerving for some, will allow us to move forward from philosophical discussions, which as Jon Mason points out are both useful and a distraction, (Higgs et al, 2003) to focus on practical applications that have organisational and educational benefits.

It is not the intention of this paper to add to the 'What is a learning object?' dialogue, an overview of which is provided in Appendix A. Instead the intention is to provide examples of how learning objects may be, or are currently applied in the VET sector and to identify the characteristics of these objects so that they may be better understood in terms of their practical implementations.

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.'

Metadata is structured data which describes the characteristics of a resource - essentially it is information about information. It helps us to locate the specific information we are looking for. Cataloguing systems that we use in libraries, museums and archives are classic examples of how we use metadata for non-digital information.

In the digital world if you need to find something you can use a search engine such as Yahoo. However, you might get some surprising items in response to your search. This is because, in the digital world, metadata systems are still developing and most searches are based on key words only. The search engine will return you all instances of the word you searched for no matter what the context.

The real measure of good metadata is the level of discovery; that is the ability to deliver a contained set of results with a high proportion of relevance to the subject matter.

Examples of metadata use

Metadata is often stored within an HTML page as name-value pairs within meta tags, which are placed within the 'HEAD' elements of the document. However, it can also be located in an external document, such as an XML file, or loaded into a database.

Toolboxes are a collection of resources, suggested learning strategies and supporting material to facilitate online delivery of qualifications from recognised Training Packages. To the end user, a toolbox is a guided course that can be delivered using a web browser. Technically, a toolbox is a collection of HTML pages, media objects, and supporting documents. Metadata is embedded within the content containing HTML pages.

Toolboxes use a metadata schema based on Dublin Core Metadata Element Set (DCMES). An example of this metadata is given below.

```
<META NAME="DC.Title" CONTENT="Activity 1 - Prepare for a function" />
<META NAME="DC.Description" CONTENT="This activity teaches students to organise themselves so that they learn to work both safely and hygienically. They will learn how to work cleanly and safely, how to select kitchen tools, how to select and prepare vegetables and how to use basic cutting techniques." />
<META NAME="DC.Subject" CONTENT="ANTA, Toolbox, THHBKA01B, prepare, mise en place, preparing, organise, setting up, equipment, preparation, kitchen, tools, commercial kitchen, cleanly, safely, hygienically, basic cutting techniques, vegetables, knife, knives, knife care." />
<META NAME="DC.Creator" CONTENT="Challenger TAFE" />
<META NAME="DC.Creator" CONTENT="WestOne" />
<META NAME="DC.Date" CONTENT="2002-06" />
<META NAME="DC.Type" CONTENT="text" />
<META NAME="DC.Type" CONTENT="image" />
<META NAME="DC.Publisher" CONTENT="sales@atpl.net.au" />
<META NAME="DC.Publisher" CONTENT="http://www.atpl.net.au/" />
<META NAME="DC.Publisher" CONTENT="Australian Training Products, GPO Box 5347BB, Melbourne, VIC 3001, Tel: +61 3 9630 9836/37, Fax +61 3 9639 4684" />
```

Each line represents a name-value pair that provides some description about the resource. The first line, using the Dublin Core (DC) TITLE element describes the title of this activity. Subsequent lines describe in detail the description, subject, creator, date, type and publisher of the resource.

There has been a lot of work done by standards organisations to define metadata elements, sometimes known as *schemas* to describe learning content/objects. The most common are the Dublin Core, EdNA Metadata Standard, the IEEE Learning Object Metadata (LOM) and the IMS metadata specification (almost identical to the IEEE LOM). This work is further explained in Appendix B.

Granularity

Learning object size, or granularity is another important issue. As Higgs et al (2003) note, '…issues of granularity are seen as fundamental to most people's concern for some quantifiable measurement of a learning object.' This high level of interest in granularity, comes from the relationship between the level of granularity and the level of reuse.

In simple terms the smaller a learning object is, the higher the level of reusability, but the lower the level of instructional value. If a learning object was to become too small then there is a danger that it may become meaningless with little if any chance of reuse. Similarly, the larger the learning object, the greater instructional content and context, the less opportunity that object has for reuse.

As the above comments would suggest, there is little to be gained in attempting to construct a definitive level of granularity, rather we must accept a degree of flexibility of interpretation. However, it is generally accepted that whatever the size of a learning object it will be composed of smaller parts (eg assets or content objects). All conceptions of learning objects will acknowledge that they are composed of smaller units. (Higgs et al; 2003)

Examples of granularity

The following examples demonstrate the range of material and granularities that can be shared and reused.

1. The AEShareNet initiative allows organisations to share resources through a standard licensing system. It is technically not a repository of objects, but a facility through which organisations can exchange resources, including learning objects, through standard licensing agreements. The types of resources can be categorised under the following broad categories:

    Assessor Resources; Competency Standard; Curriculum; Learner Resource; Promotional Material; Professional Development; Research and Policy Material; Trainer Resource; Training Package; Training Package Guide.

There is no restriction on what members can contribute for sharing (with the exception of pornography) and contributions can vary in size from a

single Assessor Resource to a full Training Package. They have recently added a 'learning object' category for 'complete learning resources'.

2. The Toolbox Repository was established to store and distribute the existing collection of content within the Australian Flexible Learning Framework Toolboxes. It is a digital repository that enables the reuse of individual resources (HTML pages) from across the Toolbox collection.

The repository works by searching the metadata from individual HTML pages within a Toolbox. When a query is made through a search engine interface, the pages with a metadata entry that matches the query are displayed. The user can then preview each page and decide whether to add it to a selected bundle of pages. The repository bundles the selected pages into a zip file for downloading. The user can then store and edit the downloaded HTML pages as required.

3. The WestOne QuickList is a collection of interactions and multimedia objects. The objective of creating such a collection was to provide a central area so that a large development team could share objects and code, and from an instructional perspective, share new ideas. This QuickList helped with the more efficient use of interaction based on generic programming functionality.

The QuickList is used during the storyboarding and development process. Instructional designers will search the QuickList for an appropriate interaction to use. They then cite this interaction in their storyboards as well as including new content for it, if there is any. When a developer takes this storyboard they then go to the QuickList to retrieve a copy of this interaction and modify it according to instructions.

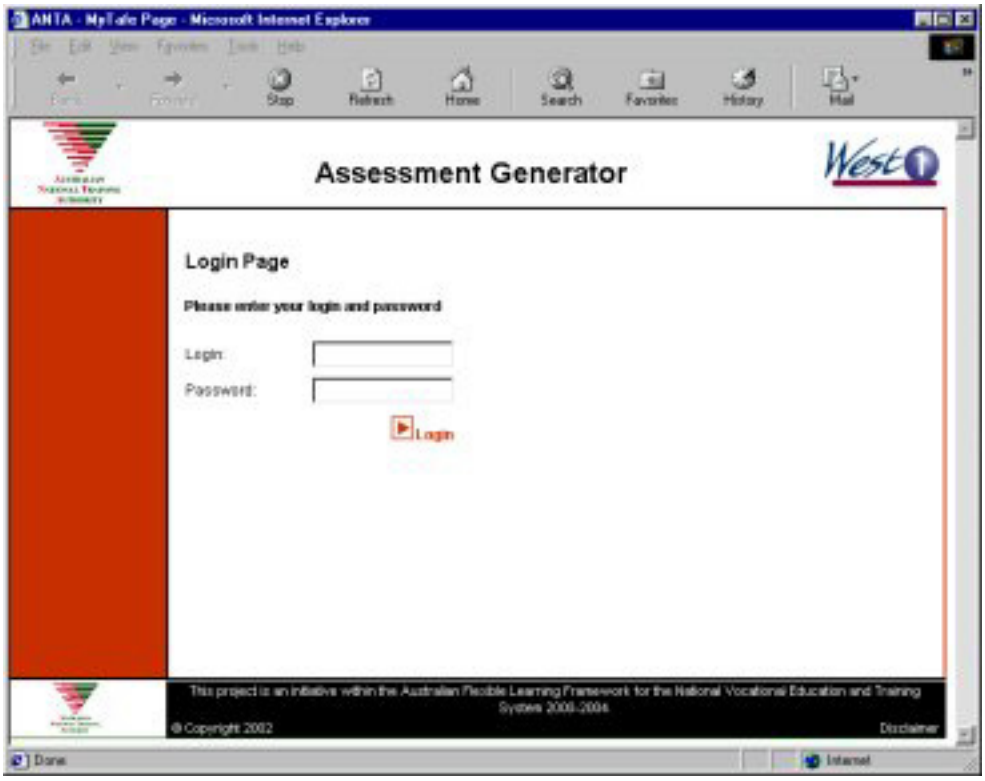
Note that in the above examples a wide range of object types and granularity are identifiable.

Scenarios

Assessment Generator

The Assessment Generator is a web-based repository that makes it possible for training practitioners to efficiently search, retrieve and assemble assessment plans and tools. This is achieved by providing a range of functionality including:

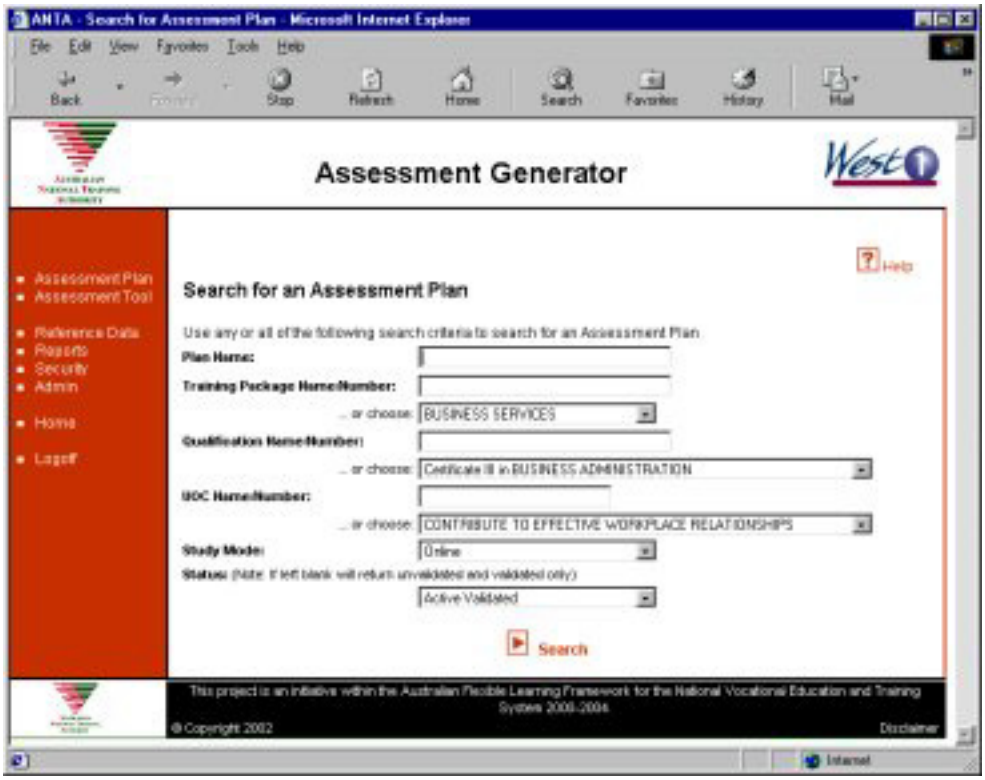
- The ability to create and manage a repository of assessment plans and tool information that may be used across the organisation or in partnership with other registered training organisations (RTO) within the VET sector.
- Assisting the RTO's in the construction of assessment materials through the intuitive manipulation of training product and assessment task information to suit assessment delivery requirements.
- The incorporation of appropriate security and assessment plan/tool and validation features.



Using the intuitive, user-friendly interface, academic staff can cluster training product information for assessment purposes and define appropriate evidence gathering tasks or methods. This process results in the creation of an assessment matrix, a key source of information for student and lecturer alike. This occurs through a process which examines and matches the assessment plan context (for example, a specific unit of competency and a specific evidence gathering task such as an assignment) with that defined for pre-existing assessment tools.

Academic staff can chose to re-use the pre-existing assessment tools (assignment, knowledge test or observation for example) in the same context or not. Their other options are to create brand new assessment tools or to copy and adapt pre-existing ones as completely new assessment tools.

Individual assessment tools can be created and associated with an Assessment Plan. In addition, other assessment information can be selected for inclusion in the Assessment Plan where appropriate. This includes text covering the appeals process, skills recognition, evidence guides and graded competency).



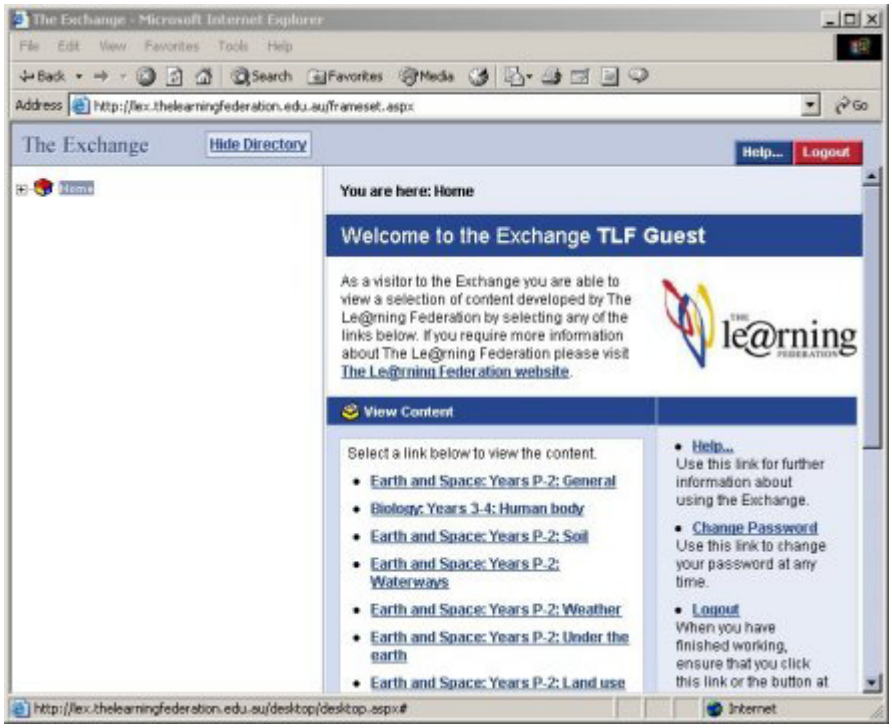
The Assessment Generator has been designed based on the following principles:

- **Efficient use of academic resources:** This is done by applying technology for the purpose of reducing the amount of time and effort required to support administrative activities, so enabling academic staff to focus on delivery activities.
- **Accessibility:** In this context, accessibility means academic staff gaining ready access to assessment information, services and systems on demand via the Internet.
- **Useability:** Useability has a broad meaning, covering not only the ease of use but also incorporates issues such as variable ICT skills amongst the academic community, diffuse information sources, limited time, limited training and in some cases, limited access to computing facilities.
- **Re-use and discovery of assessment materials:** This is achieved by automatically locating in-context assessment tools as part of the assessment plan creation process and then makes these tools available to be copied or adapted for different assessment contexts as appropriate.
- **Flexibility:** The inherent agility of web technologies, as well as the relatively low cost of deployment, makes it possible for individual states and territories and possibly individual training providers to consider their own implementation requirements.

The Le@rning Federation's Exchange

The Le@rning Federation is aiming to develop a pool of 'educationally sound quality assured content and a supporting technical infrastructure to deliver this content to all Australian and New Zealand schools through the education system' (Curriculum Corporation & education.au limited, 2002).

The content (learning objects) are distributed through a central Exchange to education jurisdictions, who will then be responsible for their own storage and distribution to schools. The Exchange also supports content development and quality assurance processes to assure appropriate educational and technical standards are being met. An open source project, the Basic E-Learning Tool Set (BELTS – http://belts.sourceforge.net), has been developed to provide a basic learning object repository that connects with the Exchange to receive and store content, and enable the content to be used in a learning environment. BELTS allows sectors to trial the processes of managing and using learning objects, enabling education jurisdictions to gain valuable experience, and to develop better requirements for fully featured solutions.



The four functional modules in the current release of BELTS are:

- administration (user management);
- content management (download content from the Exchange);
- class management (groups of people); and
- lesson management (sequencing learning objects).

It is envisaged that further functionality will be added to BELTS in future releases.

The educational integrity of learning objects means that they can be identified, tracked, referenced, used and reused for a variety of learning purposes. Learning objects are developed to function as discrete entities or be linked in order to relate to explicit concepts or learning outcomes. Content requirements are determined through communication with educationalists across the target audience and developed by independent contractors.

Within the guidelines, a learning object can be any type of digital asset such as an animation, a video clip, a piece of text, a URL or a learning sequence of digital assets, so long as those assets meet the required level of educational integrity.

The Le@rning Federation's Metadata Application Profile is based on and extends the information model used by the IEEE (Institute of Electrical and Electronics Engineers) Learning Object Metadata standard [LOM 6.4].

The Metadata elements are grouped into five categories:

- The **management** category groups information that describes the management of the object.
- The **technical** category groups the technical requirements and characteristics of the object.
- The **educational** category groups the pedagogical characteristics of the object.
- The **rights** category groups the intellectual property rights and conditions of use for the object.
- The **accessibility** category groups the object's accessibility characteristics.

WestOne QuickList

The WestOne Quicklist is an intraorganisational collection that has grown out of the desire to create reusable online design elements. The objective of creating such a collection was to provide a central area where a large development team could share objects and code, and from an instructional perspective, share new ideas.

The first QuickList started as a list of a dozen interactions without any categorisation and only a brief description. These interactions took the form of a

sample file and the code necessary for developers to customise. This was suitable for a short time until the number of objects reached a few dozen. It is a requirement that all these objects are highly, and easily, customisable.

The second QuickList was then categorised into ‘interaction type’. For example, drag and drop interaction, multiple choice quizzes, and animations. This allowed the design and development team to browse them more efficiently and improve the discoverability of the 70 or so objects it now contains.

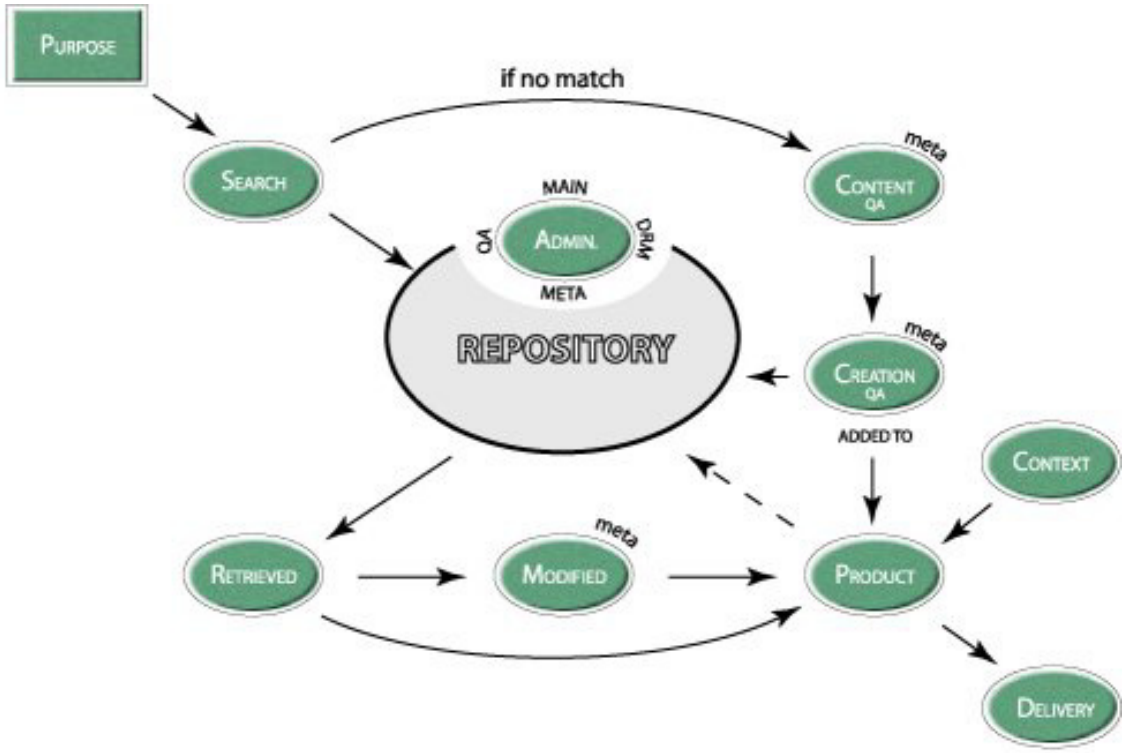
Whilst the QuickList contains good examples of learning objects, it is not a true repository in terms of either the Assessment Generator or the Le@rning Federation’s exchange. It does not search through objects, browsing has to be done manually, and it does not contain any metadata as such. It has been recognised that as the volume of objects increases, it will have to be put into a proper repository format to maintain the discoverability and usability of these objects.

The QuickList is used during the storyboarding and development process. Instructional designers search the QuickList for an appropriate interaction to use. They then cite this interaction in their storyboards as well as including new content for it, if there is any. When a developer takes this storyboard they then go to the QuickList to retrieve a copy of this interaction and modify it according to instructions.

As new products are created, the teams look at what interactions could be made into reusable objects. These are then inserted back into the QuickList in the appropriate category.

The learning object life cycle

The diagrammatic representation below is an example of how learning objects may be developed, stored and used within a VET repository.



LEARNING OBJECT LIFE CYCLE

The various components of the diagram are explained below:

Purpose: The lecturer starts with a purpose to use a resource to deliver a competency or unit.

Search: During the search phase, the lecturer will search the repository for suitable resources to meet the purpose. This may result in no matches, a single or multiple matches, or a number of close matches.

Admin: The administration function is central to the functioning of the repository. It supplies a quality assurance function to ensure that all objects have the appropriate metadata standards. This function also looks after the digital rights management component of the repository based on the DRM information that forms part of each object's metadata. The Administration function also is responsible for maintenance of the repository. This may include reading metadata tags to check the currency and version control of learning objects. Ideally the Administration function would incorporate a quality assurance function for all objects being uploaded to the repository. This may include content verification, checking copyright and educational soundness, or applying additional metadata as required.

Retrieved: During the retrieval process, the lecturer downloads a copy of the resource to a local workstation.

Modified: The modification process may be used if the resource is a close match to the purpose but needs modification. New metadata must be added to the resource to reflect the changes. The modified object can then be incorporated into a new product, which may be uploaded to the repository.

Content: During the content phase, suitable content is sourced as the basis for developing an appropriate learning object. Metadata is gathered at this phase describing the content and pedagogical attributes of the resource. Using a suitable metadata template, this could be completed by the lecturer or content expert. The completed content would be forwarded for resource creation.

Creation: The creation phase reflects the actual building of the resource. This may include conversion to digital format, sourcing video or images etc. In some cases, this may be done by an instructional designer/developer based on the content provided. As the resource is developed, the appropriate metadata would be added. The finished object is then added to a product and is uploaded to the repository.

Product: The product phase may pull a variety of objects together, including new and modified products in order to create an appropriate learning sequence. Appropriate context is added to the object in preparation for delivery. If the combination of these objects creates a new viable resource, it may then be submitted for inclusion in the repository.

Context: Context is typically provided by the lecturer as part of preparing the object for delivery. If the context significantly changes the nature of the product, then the contextualised product may be considered for inclusion into the repository.

Practical applications of the life cycle

The following scenarios demonstrate how the life cycle of a learning object may be applied to lecturers and/or product developers within the VET sector.

Scenario one

A carpentry lecturer needs a learning resource to explain how to prepare a dovetail joint.

The lecturer searches the repository and finds a suitable resource that may be a video or a small interaction. The quality of the resource can be assured through the Administrative QA function built into the repository. The Administrative function will also detail the rights under which this resource can be used.

The lecturer then retrieves the resource and feels confident that it can be used without any further modification and so applies the necessary context by demonstrating how the joint may be used in a creating a drawer for a desk and is able to deliver the product in the classroom.

Scenario two

A lecturer delivering a small business finance unit wants a resource that explains to students how to prepare a profit and loss statement.

She searches the repository and discovers a very good resource, except that it is based on a different accounting software package than the students are used to. The lecturer decides to modify the resource with new screen captures using the appropriate software package.

The lecturer may work with a developer to help modify the resource, and at the same time update the metadata to reflect the changes.

The lecturer would like the new product included in the repository for future reference and consults with the Repository Admin function that ensures that the new resource meets the required metadata, educational soundness and digital rights specifications.

The lecturer is able to apply the appropriate context to the resource in the classroom as part of the delivery process.

Scenario three

A lecturer in the automotive industry would like a resource that explains how the valve timing works on a single overhead camshaft motor.

The lecturer searches the repository but finds no suitable resource.

The lecturer knows this topic well and is confident that he can develop a resource that may even be of use to others. The lecturer takes a series of digital photos of a camshaft in operation and provides suitable text to explain the process. The lecturer can then use one of the many available web authoring packages to develop a simple menu driven website. Consulting the organisational guidelines, the lecturer will enter the appropriate metadata into each HTML page.

The lecturer then submits the object to the repository Admin function that ensures that the new resource meets the required metadata, educational soundness and digital rights specifications.

The lecturer is now able to apply the appropriate context to the object by means of demonstrating the process in the classroom and is able to deliver the product successfully.

Observations on the life cycle

The life cycle makes certain assumptions about the nature and use of learning objects within the VET sector as follows:

Objects are created based on purpose. This is to say that there is no process for creating objects on the basis that they may one day be used for delivery.

Repositories have an administration function. There is a need for all repositories to be maintained throughout the object life cycle. This maintenance may be performed by a series of automated tools, or by an individual 'repository administrator' whose duty it is to maintain the repository.

Human expertise is sought. The content creation and modification processes would require human intervention and the specialist skills of content experts, developers and designers.

Key points for consideration

1. Initially this paper intended to create a set of key characteristics for learning objects to be used in the VET sector. In hindsight, it was realised that this is inappropriate. Objects can take many shapes and forms and their creation and use should conform to guidelines to ensure:
    1. Interoperability
    2. Technical quality
    3. Metadata quality
    4. Educational quality during development and use.

    Their characteristics, however, should ultimately be determined by the requirements of specific implementations. 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.'

    Is there a need to define a set of characteristics for learning objects within the VET sector and how can we have interoperability if objects are all different?

2. In their literature review Higgs et al (2003) summarised one of the common characteristics of learning objects as follows:

    > 'Instructional value - In order to be defined as a learning object there must be some intrinsic instructional value. A learning object is not just a knowledge or information object. It should result in a complete learning sequence, objective, skill or competency (this is a granularity issue - in VET in Australia a learning object might be loosely matched against a performance criterion of a training package element of competency)'.

    There is definitely a need to differentiate between objects that instruct as opposed to those that merely provide information. Confusingly however, it would seem that many organisations and current digital repositories are using the term 'learning object' in reference to both. For this reason, it is

important to consider:

- that giving a repository the title 'learning object repository' might mean strictly limiting its contents to only objects that have some instructional value, or
- by giving a repository a more generic title such as 'object repository' it can contain objects that are informative as opposed to instructive in nature without creating undue confusion.

3. Objects which form a 'complete learning sequence' work well in some circumstances such as NETg courses for corporate training or, The Le@rning Federation objects that are highly appropriate for most school curriculum.

   An object can be reusable and of sound value even though it is not a complete learning sequence. Seng Mah notes that, 'When I was teaching, I had colleagues who would photocopy certain extracts from several books, get a diagram or two from elsewhere, compile them into their own handout and add any other different elements together.' This piecemeal approach is desirable in the VET sector where the need for highly contextualised material that a user can relate to a specific workplace presents a greater challenge for reusability.

   Is there room for a variety of both complete and incomplete components to play a role in the future sharing of resources within the VET sector?

4. An initial criticism of the Toolbox Repository is that it may return an HTML page, which has links to relational information that has not been returned by the search. When objects are deliberately selected for reuse or created and then metadata applied, the material is more likely to follow quality processes and be self-contained. By comparison, metadata applied to all material, whether reusable or not, results in a higher likelihood of content containing broken links or references, being returned by search mechanisms.

   How much information should be available in the metadata, how should it be applied and at what level of granularity?

5. By examining examples such as the WestOne Quicklist and The Assessment Generator it appears that learning objects can take on various forms. Tim Hand from OTEN has suggested that it may be possible to categorise learning objects as belonging to one of the following types:
   - asset objects
   - software code/applets etc
   - information objects
   - learning objects (discrete learning outcomes/competency)
   - simple learning sequence (combined object)
   - assessment/activity object
   - context object
   - learning design/activity objects
   - adaptive (where content is contributed to the object shell).

Such categorisation may lead to a better understanding of how different object types may be used, and may also result in more succinct metadata. What realisable benefits can the different categories provide to the VET sector?

Pedagogical/instructional design issues

There are a number of pedagogical and instructional design issues emerging as the quest for workable, interoperable and user-friendly learning object repositories gains momentum.

In no order of importance or priority, some of these issues include the:

- balance between context and reusability
- integral role of the teacher in learning
- move toward automated or formatted learning sequencing
- practicalities of object repositories.

Balance between context and reusability

Higgs et al (2003), in their literature review of the instructional issues relating to learning objects, identify the contextualisation of learning objects as a major pedagogical problem.

Contextualisation arguments range along the continuum from:

- the complete removal of context from a learning object to supposedly make it more reusable
- to the inclusion of a contextual framework to enhance learning but perhaps decrease reusability.

This continuum is well represented by South and Monson's (2001) increasingly popular diagram illustrating the relationship between context, learning potential and reusability.

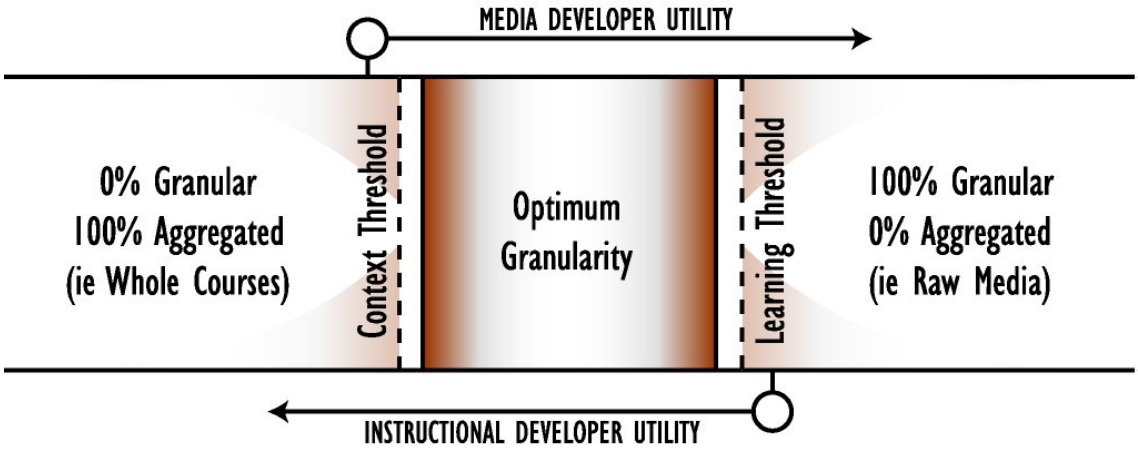


Diagram adapted from South and Monson (2001) A University-wide System for Creating, Capturing, and Delivering learning objects by Brigham Young University.

However, arguments for context neutral learning objects do not appear to be 'holding water' in the educational sector, with a number of authors and organisations maintaining that part of the uniqueness of the vocational

education and training sector is the provision of authentic workplace examples and scenarios.

Williams et al (2002) highlight the importance of context in making connections and meaning of learning objects.

Mills (2002) suggests that elements be bundled together (eg concept, examples, practice and/or assessment – be put ***into*** context) to make them more usable across environments and more likely to stand alone.

WestOne Services (2002) state that learning is inextricably linked to real-life situations and that learning material should therefore include scenarios and instances that the learner can relate to. They go on to note that their project confirmed concerns from the instructional design community as expressed by the likes of Wiley and Koper (2001), and affirmed the significant role context plays in the creation and aggregation of objects.

The Learning Federation's 'educational soundness' specifications[1] state that:

'Online content will have learner focus when it has purpose, meaning and relevance for the learners and it:

- enables learners to interact with, organise, represent, interpret and manage the process of learning and the information flow
- makes explicit the intended process/es of learning
- contextualises student learning by making connections with prior learning and likely future learning.'

Wiley (2003), in reviewing articles published in the Journal of Interactive Media in Education, states that, 'Without some sense of context binding together reusable educational resources, a "course" so designed becomes nothing more than a grab bag of apparently unrelated stuff.'

This is a view echoed by WestOne Services (2002). They found that when creating material for training packages the best approach was to work with one specific learning objective in mind, and on completion of the material, to review it for elements that might be reusable as shareable content objects (SCOs) or assets.

Higgs et al (2003) summarise their review with the statement, 'With increasing experience of instructional design in relation to learning objects, it is becoming evident that we cannot separate learning design and context. Indeed in the VET sector it is also denying the essential need for the contextualisation of information (particularly in the workplace).' They then suggest four ways of dealing with context from an instructional viewpoint:

1. include some within the learning object
2. use a parent (context free) and child (context included) object association

[1] Available from http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/educational_soundness_specification_v2_2.pdf

3. reference to context inclusive information or tasks (eg summaries, assessments etc) - skilful use of the 'DC. Relation' metadata field could be useful here
4. a blend of these approaches.

The integral role of the teacher in learning

With the gathering wave of reusable learning objects and their associated repositories, there appears to be a subliminal move to attempt to automate or completely student centre the learning experience, whereby the teacher is removed from the equation.

Wiley (2003) observes that he is not alone in believing that the trend toward automated, adaptive, personalised, or intelligent systems, or in other words, the drive to remove expensive humans from the learning experience loop, is an insidious form of cultural or epistemological imperialism. He says that we must be extremely careful that our learning environments based on reusable resources contain opportunities for meaningful discourse.

Griffiths and Garcia (2003), in a commentary on an article by Koper (2003), observe that when the role of the teacher is reduced, as it often is in electronically mediated education, the strategies available to teachers to overcome breakdowns in the learning process, are radically reduced or entirely removed.

They point out that there are a wide variety of interventions made by teachers to help overcome breakdowns in the learning process, often within the most traditional classroom settings. These lead learners to reach an understanding by supporting them in their own construction of knowledge. These strategies involve impromptu questions, problem setting, referring to the learner's own experience, etc. They may or may not be part of conscious constructivist pedagogy, and many of these interventions are invisible because they may never be recorded in a lesson plan or report.

Dalziel (2002) reflects that education sector eLearning requires a much more sophisticated educational model which incorporates multi-user 'learning activities' rather than simply (single user) content. He elaborates that these activities may include the use of chat rooms, discussion boards, assessment systems etc and as they may require more than one learner, suggest a different type of eLearning standard to those applicable to corporate training.

WestOne Services (2002) agree that the role of the educationalist should be considered. They note that lecturers often pick and choose from a number of resources to support their teaching. Likewise they may refer their students to a range of resources relevant to their particular subject matter. Irrespective of whether these resources are traditional books or digital learning objects, the lecturer is entrusted to use them in an instructionally sound way and provide a context in which they should be applied. Wiley's concerns are more pertinent in the absence of this direct human input when, for example, a selection of

autonomous objects is retrieved electronically by either a computer agent or an LMS/LCMS and presented to a student as a stand alone 'course of learning'.

Student to teacher and student to student communication should always be an integral part of learning. Whether the class is face to face, purely online or a mixed mode format (research[2] shows that this is the way most Flexible Learning Toolboxes are being used), the involvement of the teacher is vital to the dynamics of the group. Automatic generation of object content supplied as a stand alone unit to students should never be our goal.

Learning objects and their repositories should be treated as additional resources from which the teacher can draw. These can help add greater flexibility to the VET learning environment – for example students could use online resources drawn together by the teacher to cover theoretical aspects of a course at home prior to a face-to-face session, thus allowing more time to cover practical competencies of the unit. The ability of the teacher to contextualise objects and/or integrate them into learning activity sequences is implicit to the learning object paradigm.

Move toward automated or formatted learning sequencing

IMS Global Learning Consortium, Inc. (IMS) is the organisation developing and promoting open specifications for facilitating online distributed learning activities.

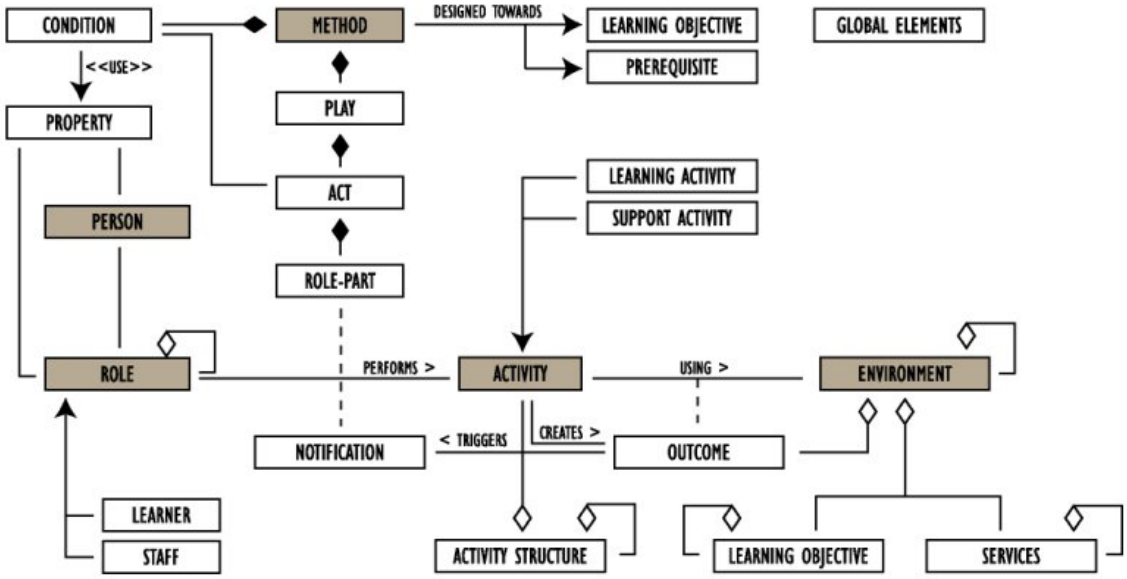
IMS has recently released an information model that is an integration of existing IMS specifications with the Educational Modelling Language (EML) developed by the Open University of the Netherlands. This model is known as the IMS Learning Design (LD) Information Model and is an integration of EML and existing IMS specifications. LD is an attempt at marrying the exchange of learning objects from a range of repositories with a variety of pedagogical approaches.

Higgs, et al (2003) recognise that LD is a first step in applying a learning sequence within and between learning objects and that for this to occur, instructional designers/teachers need to be able to:

1. choose the appropriate learning objects
2. look at ways of sequencing and contextualising them
3. embed the final product in an instructional framework.

However the LD is a vastly complex model, as can be seen by its conceptual model diagram below. Simpler tools are required for even early adopters.

[2] Evaluation of the usage of national flexible learning toolboxes (Series 3) – Final Report, February 2003, Access Testing Centre.



Conceptual model of overall Learning Design

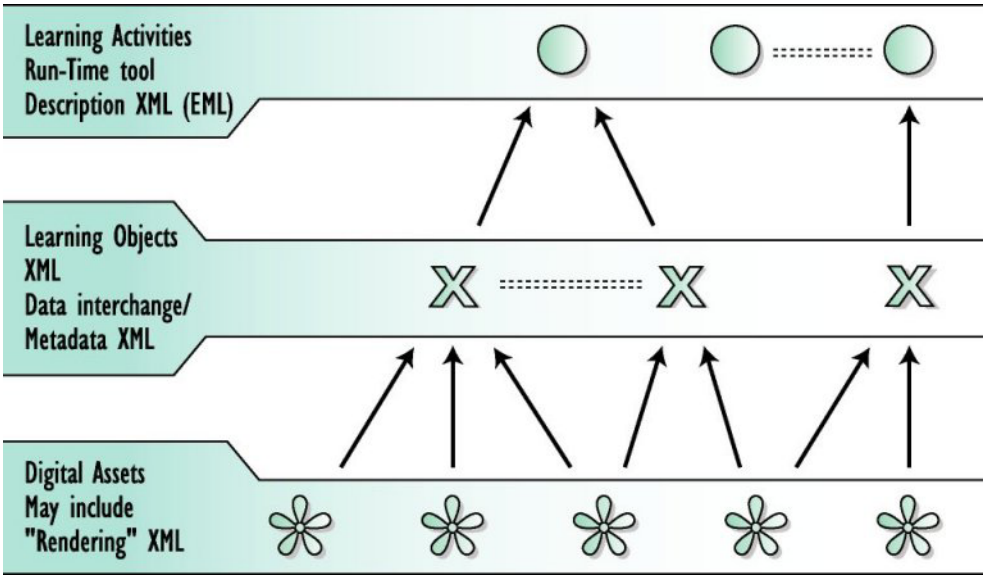
Sloep (2003) in a commentary on a paper by Laurillard and McAndrew makes the salient point that, 'although Learning Design's modelling language is significantly simpler than a full-blown programming language, it is still too hard for most teachers. This may be remedied by creating another piece of software, a Learning Design editor.'

Sloep notes that, 'the situation may be compared to web editing in HTML. In the early days, HTML was hand-coded in generic text editors. Subsequently, various generations of dedicated HTML editors were developed and now everybody can put up a decent website (although for really powerful applications a text editor still is an indispensable tool).'

He believes, 'something similar should happen with respect to Learning Design. Currently, only generic text editors exist. Ultimately, it is to be hoped that dedicated LD editors will be built that are powerful yet sufficiently simple to be used extensively by teachers. Since LD is a public and open specification, perhaps a range of editors will be developed, from simple ones that are geared towards one particular learning design each, to complex ones that are template driven and capable of addressing a whole raft of different designs.'

The Collaborative Online Learning and Information Systems Demonstrator Project (COLIS) categorises learning objects into three tiers:

Tier 1. digital assets
Tier 2. learning objects
Tier 3. learning activities



Adapted from Dalziel Reflections on the COLIS (Collaborative Online Learning and Information Systems) demonstrator project and the "learning object life cycle". (2003)

This project has the potential to look at offering tools to help teachers sequence a number of learning objects into a learning activity and a number of learning activities into a learning activity sequence.

WebMCQ is working on software to allow for the integration and sequencing of learning objects with associated activities in an easy-to-use drag and drop graphic user interface.

The practicalities of object repositories

Digital learning objects are resources just like any other. We need to help teachers see this and dispel anxieties about using them. Perhaps the best way to do this is by:

- demonstrating existing repositories and current usage of digital resources
- sharing case studies of successful implementations
- marketing what is available
- training and professional development.

Teachers may express concern about losing control to fully automated systems. Current repositories allow teachers to decide what resources they use and in what order they present them in a lesson. Some systems allow them to edit objects; others don't. Whether this matters or not depends on individual requirements. For instance, in an interview with Graeme Brownfield, the current and previous managers of the ANTA Resource Generator remarked that users 'prefer a choice of customising a Word document or retaining the appearance of a PDF document, according to their priorities.'

There is a concern that teachers may be put off by not being able to dynamically view and interact with objects. Some repositories demonstrate excellent digital rights management capabilities. However, in achieving this,

options for the end user have been somewhat compromised. They may have access to metadata only and have to apply for a 'viewing period' of an object before deciding if it is appropriate. Also, the protection of copyright may prohibit them from editing the object in any way.

Using online teaching materials does require more organisation and forward planning by teachers. Professional development and training is required to help teachers to adopt a new approach whereby time for obtaining material, copyright clearance and contractual agreements become part of the normal workflow practices.

Market research

The Le@rning Federation carried out market research to identify:

- patterns of usage
- profiles of special groups
- teaching and learning strategies appropriate in the online environment
- strategies for targeting the identified groups with online curriculum content
- barriers to the full adoption of online curriculum content.

A total of 276 teachers responded to an online survey and qualitative data was collected through interviews and classroom observations with a further 85 teachers in 27 schools. As a result of the research, the following recommendations were made as guidance for the development of future online materials.

1. The materials should be developed with a view to bridging the divide between instructional design and digital learning object design.

2. The materials should support the current syllabus statements and curriculum frameworks.

3. The materials that are developed should be accessible, generative, adaptable and scalable.

4. They should fully support any place and any pace of learning.

5. The materials should be authentic, capable of engaging students and facilitating creativity and higher order thinking skills.

6. The materials should include assistance for teachers in the way of teaching notes, lesson plans, explanations, links to other resource materials and direct curriculum links.

7. The materials should provide a means whereby teachers and students can communicate and exchange ideas.

A market research report produced by the Federation found that quality professional development for teachers was a key component in facilitating fruitful use of online materials. They have planned professional development of teachers to take place in a staged manner, allowing time for systems and sectors to learn from trials and small-scale implementations.

Key points for consideration

1. To make the most of learning objects and repositories it is likely that teachers require training and information in a number of areas such as:
    - what repositories are available and how to access them
    - how to get objects from a repository
    - how to incorporate objects into their training materials
    - strategies for integrating objects into a coherent flow
    - delivering completed resources to students
    - basic HTML skills for editing
    - dealing with digital rights requirements
    - planning ahead of time to allow for copyright clearance and contractual agreements to take place.

    What level of training would be required to ensure appropriate usage of a repository within the VET sector?

2. Fully automated systems that provide users with 'just in time' training, such as the Help facility in a software package are useful in some situations and seem to work well in corporate training. In the VET sector, learning is predominately teacher-led and even systems that are developed to be 'learner-driven' will require human input at some level: teachers, mentors or workplace facilitators. The TAFE Frontiers C-2-C Action Research Project raised the issue that, 'if the teacher holds the key to learning, then the learner can't get access without the teacher'. They suggest that, 'to think in terms of learners having "agents" to assist their learning, might help formulate a new set of relationships.'

    Should the proposed model for a VET Learning Object Repository be one that is fully automated or one that requires lecturer intervention?

3. Some form of advertising is required to raise teacher awareness of available repositories, especially those at a State or National level. Newsletters run by repository managers can assist busy teachers by announcing new resources and sharing discussions and feedback on object use.

    Raising teacher awareness may only be feasible once an infrastructure is in place at an organisational level. Organisations must first decide the ways in which they want to share and reuse and whether or not they want to be members or collaborators in systems such as EdNA and AEShareNet. They must work out pricing and any restrictions such as State regulations before tackling issues of educating teachers and

adapting workflow practices.

How important is it to raise awareness of VET Learning Object Repositories, and who should be the main audience? At what stage should this occur?

Object 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.

Overview

A repository may either contain both the learning object and associated metadata, or merely the metadata, and act as a tool to locate learning objects[3]. In either case the repository may support any number and type of objects in varying complexities and degrees of granularity.

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.

In addition to the above, there is a growing need for learning object repository models to assist in providing a certain level of 'learning object management', that is, a repository should include appropriate mechanisms to cater for a range of administration functions including digital rights management, security of access and management of the learning object life cycle.

Repository models

Most learning object repositories are stand alone. That is, these repositories function a lot like portals in that they contain a web-based user interface, a search mechanism, and a means of retrieving a learning object.

Within this stand-alone architecture, there is the potential for two major models or repository. The most common suggests a centralised model in which the learning object metadata is located on a single server or website[4]. This website

[3] As is the case with AEShareNet.
[4] As previously mentioned, the learning objects themselves may be located somewhere else.

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.

Examples of current repositories

The following examples demonstrate the range of repositories currently in use both in Australia and internationally. These repositories represent a range of different models, architectures and implementations available.

Resource Generator

The Resource Generator is an initiative of the Australian National Training Authority (ANTA) and the Commonwealth Department of Education, Science and Training. It was established around 2000 to make Crown copyright materials available via a web interface. Some initial resources were loaded and steady growth followed. Visits to the site averaged 80 per day in November 2001, 100 a day in November 2002 and 150 by May 2003. The more resources that are added, the more people use it and the fact that it is free makes it popular with users.

Resources are mainly in two formats: PDF and word documents. Word document resources can be adapted by users and re-registered with the Resource Generator. Copyright of amended documents remains with the original owner, usually the Commonwealth of Australia (Department of Education and Technology) or ANTA. For some subject areas only PDF resources are available since allowing customisation could have litigation implications.

In 2002, a project manager was appointed, selected industry groups (mainly ITABs) were funded to load resources, and a reference group established for

ongoing review. The industry groups responsible for the original resources were also contracted to review the materials and provide feedback on their currency.

Metadata is applied when resources are uploaded, and is thus the responsibility of the resource developer. There are eight mandatory VET fields from the EdNA metadata schema plus some others. This metadata is stored in a database separate from the resource itself.

To raise awareness, the Resource Generator is marketed through Fast Facts, conferences, ITABs and marketing products such as pens and notepads. There is a user guide on the website and some workshops were held in all capital cities late in 2002. A significant evaluation of use is underway and due to be completed at the end of May 2003.

The Assessment Generator

The Assessment Generator (discussed earlier in An overview of learning objects) was a project undertaken by WestOne Services on behalf of the Flexible Learning Advisory Group (FLAG) under the auspices of the Australian Flexible Learning Framework and funded by the 2002 Flexible Learning Innovations initiative.

Essential the Assessment Generator is a repository of assessment tools (assignments, quizzes, case studies etc) that are aligned to individual units of competency within a training package. Lecturers can create and customise their own assessment tools or select a range of pre-existing tools. These assessment tools can then be combined in assessment matrix which forms the basis of an assessment plan.

The Assessment Generator is a database driven repository, and users search for a specific tool using a series of drop-down lists and check-boxes selecting a specific unit of competency and assessment method. Unlike many other repositories it does not support a keyword search function and no metadata is recorded for individual plans or tools.

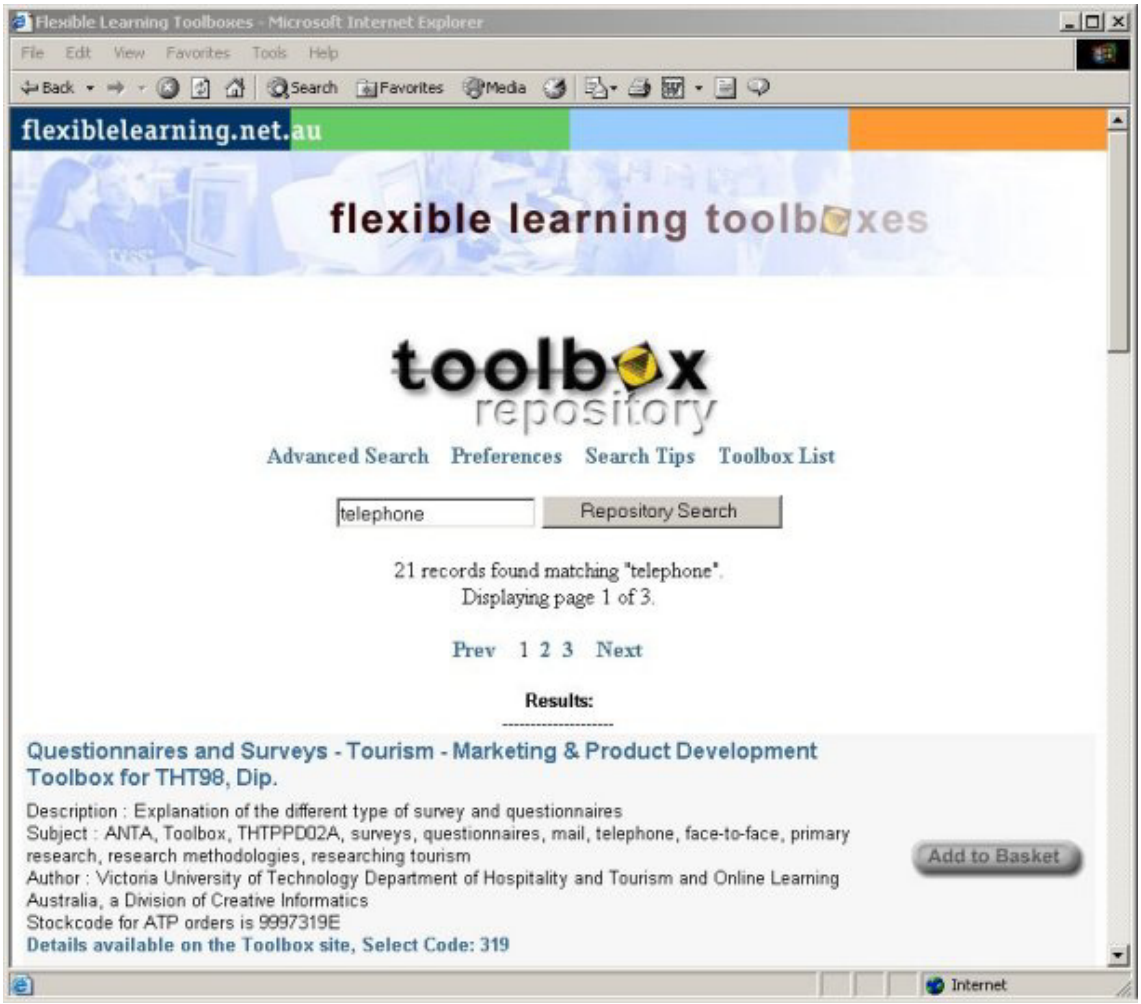
Toolbox repository

This repository was established to store and distribute a pre-existing body of content - the collection of Toolboxes developed within the Australian Flexible Learning Framework. While each Toolbox supports delivery of a specific Training Package, many of the materials, particularly those related to generic skills areas, are useful to teachers and trainers in other industries.

The Toolbox repository is unique in that it does not contain a selection of purpose-built learning objects, but rather the repository enables the reuse of individual resources from across the Toolbox collection. However, there are several aspects of the Toolbox design that support reusability of the materials in this way:

- The treatment of learning tasks, learning resources and learning supports as discrete entities in the design process facilitates their use in different settings. Toolboxes typically make use of problem-based scenarios in which learners need to locate resources in a mini-repository, such as a lunchroom or bookcase.
- To allow for customisation to meet local needs, the specifications require that users can disaggregate individual segments from a Toolbox as an alternative to selecting discrete competency units or using the Toolbox as a whole.
- EdNA metadata, based on the Dublin Core standard, is applied to each HTML page that contains content within a Toolbox. Page level granularity was chosen as each Toolbox implementation can consist of a unique online collation of pages. A description of any embedded resources is included in the metadata of the HTML page from which they are accessed.
- Toolbox content remains the property of ANTA and is subject to Crown copyright. This cuts down on the need to closely monitor digital rights management (DRM).

The repository works via a robot that reads the metadata from the HTML pages and stores it in a database. When a query is made through a search engine interface, the pages with a metadata entry that matches the query are displayed. The user can then preview each page and decide whether to add it to a selected bundle of pages.



The strength of this repository lies in its ease of use. New users should have no trouble jumping in and beginning to search for objects. The repository also allows users to add objects to a basket for later download. Objects are then packaged up into a compressed file that is then downloaded. This feature makes it easier to download and reuse objects as it includes all files that are necessary to run the pages, but may not work on pages with complex coding.

A major issue with retrieval of individual pages is the possibility of missing links if a user does not choose to download related pages. This is being addressed with a frameset that will allow the selection of pages as the user navigates through the Toolbox in preview mode. This will be incorporated in the next release of the repository expected in July 2003.

AEShareNet

The objective of AEShareNet was to streamline the licensing of intellectual property to enable Australian training materials to be shared efficiently and to assist practitioners in discovering and using online resources. It consists of:

- ‘A legal framework that this is the embodiment and formalisation of several years of collaborative agreement building (sometimes called “the AEShareNet model”).
- A website which allows anyone with Internet access to search in a single location for training materials. For organisations that have joined AEShareNet it provides much more - members can take out a licence to use and adapt other members' training materials, often in a single online transaction.
- A company called AEShareNet Limited, which is owned by the Ministers of Education and Training which manages the whole process.’ Gilding and Fripp (2003)

AEShareNet then is not a repository of objects, but a facility through which organisations can exchange resources, including learning objects, through standard licensing agreements. The objects are catalogued using a mix of metadata standards drawing from Dublin Core and a variety of VET specific fields.

AEShareNet offers the standards simple search feature as well as an advanced search feature. This advanced search is tailored towards users from the VET sector as it allows the user to search for specific VET subject codes as well as other advanced options such as material type, media format and qualification level.

When users select a search result, they are presented with a page that gives a description of the object, further information on licensing and a link to request a licence for that particular object. This prevents the objects from being used in any way until a licence for use has been approved. The downside of this model is that the user has to rely on the description of the object to assess its use, as they cannot see it until after they have applied for a licence.

From an organisation’s perspective, AEShareNet provides an easy way to license out learning material and an opportunity to obtain quality content that can quickly be reused. It is early days yet and too soon to judge the success of this process. AEShareNet will be actively monitoring how practitioners are able to implement learning objects and other resources in their teaching.

As a repository, AEShareNet provides a framework for the sharing and reuse of learning objects and the processes and lessons learnt are applicable to learning object repositories.

EdNA

EdNA Online was developed as a major repository of information for and about Australian education. It commenced in 1996 and was jointly funded by State, Territory and Commonwealth governments. The repository holds information in a range of formats: learning materials, networks, authorities, policy, industry information, traineeships, packages, support services, training providers and research.

The EdNA VET Online project aims to develop the VET component. During 2003, they will work collaboratively with the Australian Flexible Learning Framework (AFLF) in developing content guidelines and metadata standards to assist interoperability.

The Le@rning Federation

The Le@rning Federation (discussed in detail in An overview of learning objects) distributes learning objects through a central Exchange to individual schools that will then be responsible for their own storage and distribution. The Exchange will also support content development and quality assurance processes.

An open source project, Basic E-Learning Tool Set (BELTS) has been developed to provide a learning object repository that connects with the Exchange to receive and store content. It allows sectors to trial the process - download of content into their systems and teachers engaging with content.

The Le@rning Federation's Metadata Application Profile is based on and extends the information model used by the IEEE learning object metadata standard and both the objects and the metadata are stored within the repository.

MERLOT

Multimedia Educational Resources for Learning and Online Teaching (MERLOT) is an open source initiative that provides learning materials for higher education. Their website provides metadata about resources including annotations and peer reviews and links to the resources themselves (the repository only stores resource metadata and not the resource itself). Anyone can use the materials but by becoming a member (free to join) you can contribute content, add assignments to use with content and make comments on content.

Users can browse by subject or search by key words. The material is web-based and mostly free for educational use. Where licensing regulations or costs are involved users must contact and deal with the owner or creator. Otherwise they can simply add the URL to their course web page or email it to students. Objects in the MERLOT repository can range from single web pages to entire websites.

The peer review system is popular with users but requires a degree of input that could be difficult for most repository facilities to administer. According to their website, there are currently 13 editorial boards involved in the process with each review being 'conducted by at least two higher education faculty members who, from their individual reviews, compose a "composite review" that is posted to the website'. Content is reviewed on a 1-5 star rating against three

categories: quality of content, potential effectiveness as a teaching tool and ease of use. An average of three stars is required before the material is added to the website.

Once users have selected an object, or objects, they can then add them to their online collection so they can access them from a central area. Whilst this provides quick access to the objects, it doesn't provide then in a format that is easy to alter or store offline. In fact MERLOT recommends that to use the resource you find you either add a link to the material from your course, or distribute the location directly to the students. There is no centralised DRM in this repository, leaving it up to the user to check any licensing regulations or costs involved.

iLumina

iLumina is a repository for undergraduate teaching resources specifically for the areas of science and mathematics. It is similar to MERLOT in that the objects are not centrally stored but rather are accessed via an external link. All the objects are catalogued via IMS compatible metadata.

The iLumina repository takes a very similar approach to MERLOT in that they both give a standard search box, advanced search options and also the ability to browse the entire repository. Where iLumina differs is in this browse feature. Instead of just being broken up into areas of discipline, it is further broken up into:

- Resource type
  Such as teacher tool, example, assessment, simulation and so on.
- Structure
  If the resource is an individual resource or part of a larger collection.
- Media type
  If the resource is a web page, word processing document, video etc.
- Contributors
  The list of resources that belong to specific publishers, writers or even submitters.

iLumina does not directly manage copyright through DRM, but does provide some information on the copyright of the objects so the user can see at a glance what restrictions are placed on its usage. Like MERLOT this is because the objects are not centrally managed, limiting the potential use of the objects.

Comparative notes

Each one of these repositories has its own particular strengths and weaknesses and also some are more suitable for certain uses than others. Out of all the repositories, they are all suitable for practitioner and organisational use, but only Merlot and iLumina would be easy enough for students to use. If the repository was for internal use only, or DRM was not an issue, then the simplicity of the Toolbox repository would be ideal.

From the perspective of developers and designers, the Toolbox repository provides features that make it easier for them to take objects out of their context and modify them. Repositories that link to external objects make this not only technically harder, but also have more issues with copyright.

From the perspective of a lecturer, the repository model such as the Assessment Generator with its ability to modify and upload assessment objects may have particular appeal.

Repositories that provide alternate ways to browse and search objects, like AEShareNet, iLumina and MERLOT do, may increase the discoverability of objects. However, it is possible that in adding too many search options may confuse the user.

Key points for consideration

1. Fripp & Macnamara point out that In Australia, there are eight States and Territories, and differences in policy for Commonwealth versus State/Territory approaches and ask the question, 'is there justification for a single repository or is a portal approach with seamless links to State databases more appropriate?'

   In discussing the AEShareNet, Carol Fripp commented that organisations like to retain control of their resources but want the facility to be able to exchange them. Initiatives such as AEShareNet and EdNA assist them in doing this.

   Is a national VET Learning Object Repository appropriate, or should there be a series of individual state (or organisational) based (and managed) repositories?

2. The authors of this paper recently asked several VET practitioners what sort of features they would like to see in a learning object repository? The following are some of the desired characteristics:
   a. Being able to see the object up front before any contractual obligations are entered into.
   b. Simple, non-intimidating design and structure.
   c. Being able to get the object that you want straight away.
   d. Being able to store the object on your own computer or on the web-based repository associated with your login.
   e. Simple versus advanced.

   How important are these characteristics for a VET Learning Object Repository? What are the key characteristics in developing the ideal repository?

3. The Internet is potentially the world's largest resource of digital information. Many VET practitioners are already using various Internet search tools such as Google to help them source a range of possible

learning materials within the classroom.

With the vast amounts of information available on the Internet is there a need for Learning Object Repositories?

Digital rights management

While it is not the intention of this paper to delve into the intricacies of copyright law and legalities of digital rights management, it is well recognised by many authors that DRM is an important issue for consideration when developing any form of repository.

As part of the Australian Flexible Learning Framework New Practices, the Open Training & Education Network in NSW is currently leading a project to develop a 'Framework for Rights Enabled Learning Object Exchange Trial'.

As Tim Hand notes, 'The trial will involve analysis of current licensing agreements both overseas and in Australia to help develop a set of suitable licence templates … appropriate to the VET sector.'

While the VET sector eagerly awaits the outcomes of this project, a broad overview of DRM is discussed here.

Overview of digital rights management

The digital rights management 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.

The Copyright Amendment (Digital Agenda) Act 2000, came into operation across Australia in 2001. The aim of the Digital Agenda was to broaden the protection already available in the print environment to include digital assets. For more information see: www.copyright.org.au.

Organisations within the VET sector have been in the business of developing resources mainly for internal consumption. Higgs et al (2003) report that, 'education and training is becoming big business, albeit that government financial policy has driven this, that is education and training is now undertaking far more "fee for service" activities than it did in the past to help support its own existence.' The commercial exchange of resources at a national or global level requires new development processes that include pricing models, marketing avenues, quality assurance, publishing and copyright procedures.

With regards to copyright management, AEShareNet found that many organisations were 'woefully ignorant' and followed practices that exposed them to litigation risk. Fripp & Macnamara (undated) report that, 'Large numbers of educational resources could not be "copyright cleared" because of third party owned "objects" inside the resources which were not able to be disseminated/traded into the wider community.'

Higgs et al (2003) recommend that training organisations planning to deliver 'fee-for-service' type activities should seek legal advice about those activities in relation to their legal obligations under the law. They will need to keep practitioners informed of their responsibilities and provide procedures to ensure compliance with laws and regulations.

Tracking digital rights

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

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

More comprehensive schemas such as the Open Digital Rights Language (ODRL) have been developed to express terms and conditions over digital content including permissions, constraints, obligations, offers and agreements. ODRL can be used in a range of different industries and has been implemented in the COLIS demonstrator project.

Digital Object Identifiers (DOIs), explained further in Appendix B, provide a unique identifier for digital objects in the same way that an ISBN numbers identify books. This identifier can be used to track the object for the purpose of rights management.

Learning object exchanges (LOX)

The Learning Object Exchange Trial Project being run by the Open Training & Education Network in NSW is part of the Australian Flexible Learning Framework New Practices. This project aims to provide a framework for the management of DRM within a Learning Object Exchange (LOX).

A LOX typically enables the publishing and exchange of learning objects and their components within and between organisations such as universities, schools, colleges, corporations and learning content developers.

The LOX stores, promotes, trades and delivers components and the rights required for their direct use, adaptation or embedding in other learning modules. The Learning Object Exchange Trial demonstration LOX will allow for the publishing, discovery, licensing, trading, sharing and acquisition of learning objects. As Tim Hand notes, 'Such a system would interface with a repository but not necessarily be considered as a requirement for any repository'.

Key points for consideration

1. Complying with copyright laws and managing digital rights information is a critical issue for organisations especially if they are creating content for fee-for-service or licensing their resources to others. Practitioners need to be aware that developing materials for online and reuse is different from the traditional process of developing materials for their own classroom work. They need to be aware of their responsibilities to comply with copyright law, privacy and content regulations. They will require:
    - quality information on legal issues
    - a good understanding of the implications of these issues
    - procedures to follow to ensure compliance
    - training/support in obtaining information and following procedures.

    What are the implications of a digital repository in terms of digital rights management and how can they be addressed?

Metadata

There has been a lot of work done by standards organisations to define metadata elements, sometimes known as *schemas* to describe learning content/objects. The most common are the Dublin Core, EdNA Metadata Standard, the IEEE Learning Object Metadata (LOM) and the IMS metadata specification (almost identical to the IEEE LOM).

SCORM

The Sharable Courseware Object Reference Model (SCORM 1.0), also more recently referred to as the Shareable Content Object Reference Model Initiative was released by the Advanced Distributed Learning Network (ADL) in January 2000.

The SCORM specification is actually a collection of specifications to create a 'unified content model' to enable the reuse of learning materials across a range of products and platforms. It includes:

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

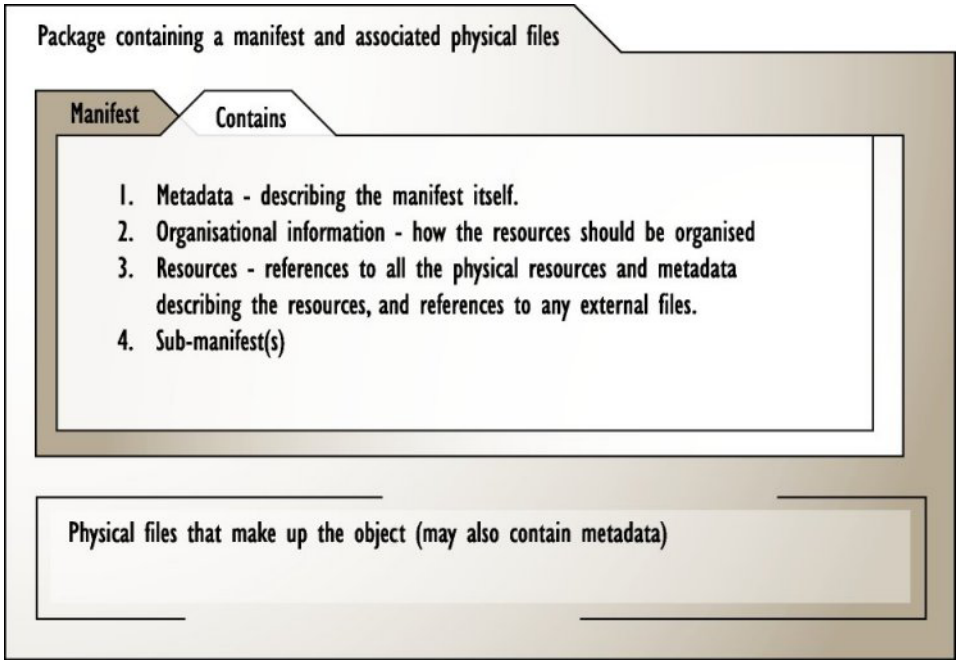
As an indication of the importance of this specification, the US federal government has declared that any eLearning provider that wants to do business with it must be SCORM-compliant (Brennan and Funke, 2001).

IMS content packaging specification

The IMS Content Packaging Final Specification Version 1.1.2 was released in August 2001. The objective was to provide a common framework for the packaging and description of learning material. The specification is aimed at both content developers and learning management system vendors. Content packaged in XML format in accordance with the specification could be distributed on a range of compliant learning management systems.

The standard has been integrated into the SCORM specifications. It is currently being tested in the COLIS demonstrator project.

The IMS/SCORM specification defines a package as a chunk of reusable content. It is represented in the form of an XML manifest file with the predefined name *imsmanifest.xml*. See diagram:



IMS Digital Repository Interoperability (DRI) specification

The IMS Digital Repositories specification was released in January 2003. It provides a set of recommendations to assist interoperability between repositories. They 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.

Scenarios

The more comprehensive the metadata for a learning object, then the greater the inherent discoverability and manageability of that object. However, a balance must be struck between the complexity of metadata and the costs involved in providing that complexity.

The following scenarios demonstrate at least two different approaches to the implementation of metadata standards in dealing with these complexities.

EdNA

EdNA is a good example of a metadata implementation. Millea explains:

'The EdNA Metadata Standard was developed to meet the need for interoperability – that is to meet one of the goals of the EdNA collaboration – information sharing and reduction of duplication of effort in the education and training sector. By using an interoperable dataset for resource description, states and territories can [and do] have their metadata harvested [imported] as they create it on individual pages, or if they do have repositories, their repositories can be harvested into the EdNA

collection. That is, EdNA Online becomes a national aggregator of metadata about education and training resources.'

Simultaneously, as mentioned earlier, EdNA Online can export all or parts of the EdNA metadata repository back to the States and Territories or to the Commonwealth using XML [extensible mark up language] or OAI [Open Archives Initiative]. The use of an interoperable metadata platform enables national information sharing and the capacity to enable multiple points of resource discovery for education and training resources.

The EdNA metadata standard is based on the Dublin Core Metadata Element Set (DCMES) and is consistent with Australian Government Locator Service (AGLS). This standard also includes a few EdNA specific categories such as:

- EDNA.Audience
- EDNA.Approver
- EDNA.CategoryCode
- EDNA.Entered
- EDNA.Indexing
- EDNA.Review
- EDNA.Reviewer
- EDNA.Version

These additional categories are primarily for the purposes of administration and maintenance.

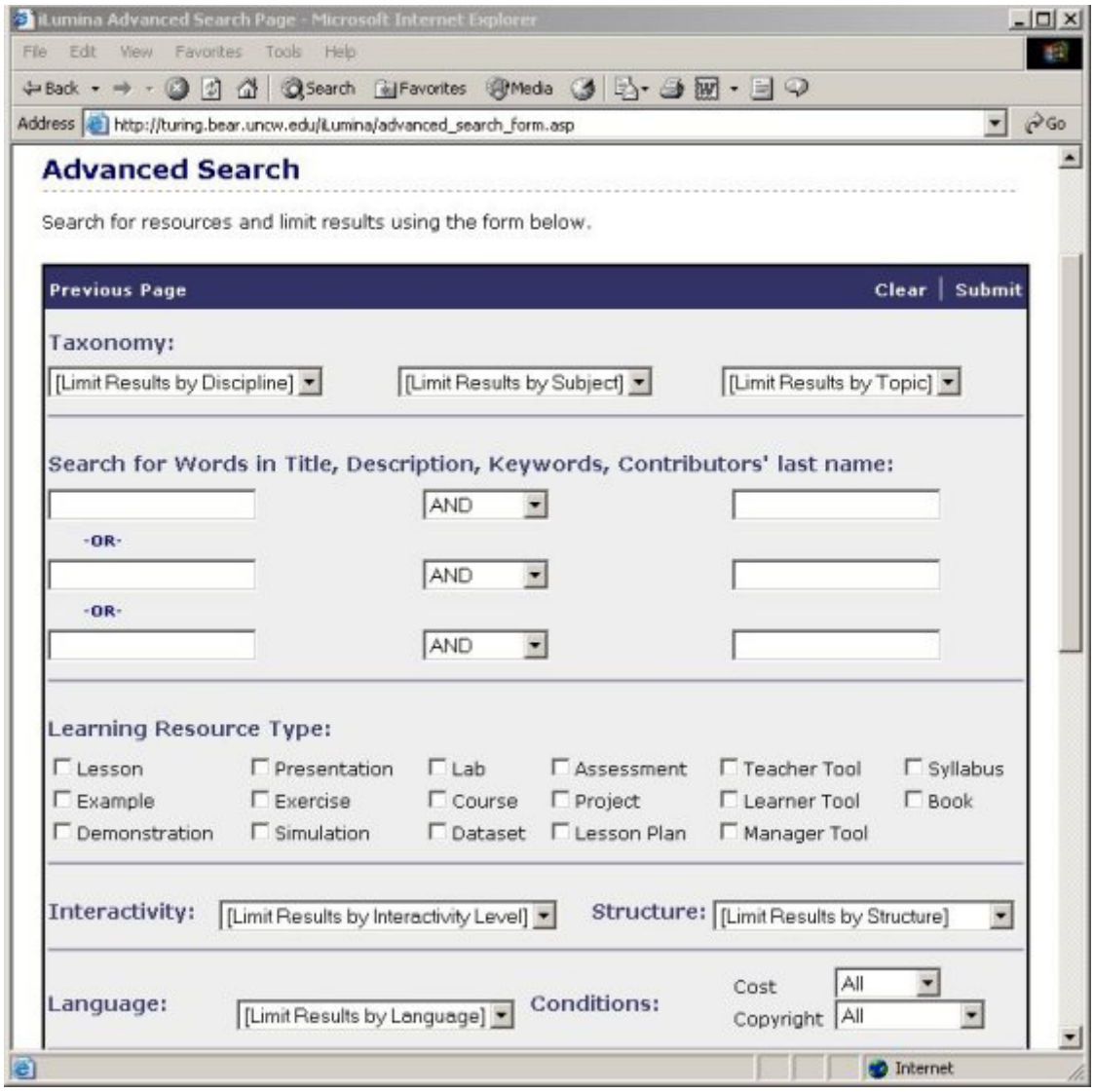
Whilst the EdNA metadata standard is being used quite broadly, currently there is no agreement in the sector about minimum requirements for metadata required for a specific resource. This means that the metadata applied to a resource may differ from organisation to organisation. This potentially poses problems for interoperability across different systems if used on a national resource sharing level between one or more sectors or organisation. A standard minimum set would prevent this problem easily.

The current version of the EdNA metadata standard (1.1) is used in the Flexible Learning Framework Toolbox repository. It is important to note however, that the current EdNA metadata standard was primarily intended to facilitate discovery of online educational resources and not intended as a standard for learning object repositories. EdNA is currently reviewing this and conducting national workshops to get input from across the education and training sectors on how to improve their standard for this purpose.

iLumina

iLumina is a repository built by a group of American universities. They describe it as a 'digital library of sharable undergraduate teaching materials for chemistry, biology, physics, mathematics, and computer science'. ILumina has been designed to quickly and accurately connect users with the educational resources they need.

The resources are catalogued with IMS-compliant metadata, which captures both technical and education-specific information about each resource. The user is provided with several search options: a quick search feature, a browse utility or advanced searches as shown below.



This advanced search is possible due to iLumina's rich metadata, derived from the IMS specification, which is organised into nine metadata categories:

- metametadata
- general
- lifecycle
- technical
- educational
- rights
- relation
- annotation
- classification

Each of the nine categories focuses on distinct features of a resource, including its construction, topic, ownership and end user rights. This not only enables

powerful searches, but is also the basis for several second-tier user services, such as capturing family relationships between resources. Formally, this could be done using the IMS relation metadata category in an XML environment as described below:

```
<relation>
        <kind>IsBasedOn</kind>
        <location>[URL of this object]</location>
        <description>This object is a variant of a previous one</description>
        <kind>IsPartof</kind>
        <location>URL of related object</location>
        <description>This object is a component of a new one</description>
```

(adapted from McArthur et al 2001)

The iLumina metadata can also provide the basis for several other valuable services including:

- collecting formal reviews and informal ratings;
- coordinating metadata construction by library community members - authors, reviewers, cataloguers, and end users; and
- connecting library community members to other users as well as to digital resources.

What standards should be followed?

Which standard implementers and developers adopt will depend on the requirements of their specific implementations. However, complying with existing standards is imperative to obtain interoperability. Developers need not use every element within a standard. They can also use elements from more than one standard and add elements specific to their needs. The resulting list of elements is known as an application profile.

In their paper, Building Educational Metadata Application Profiles, Friesen, Mason and Ward discuss the challenge of catering for both local requirements and wider interoperability considerations. They look at two application profiles: The Le@rning Federation Application Profile (TLF 0220), which combines elements from LOM, Open Digital Rights Language and accessibility statements; and CanCore (CanCore 2002), that uses a subset of LOM elements.

Closely following existing standards and best practices will greatly assist mapping between the various schemas/profiles and the achievement of interoperability on both a semantic and a technical level. Compliance with the standards is also desirable since adoption by software organisations will influence future development tools. For instance, Macromedia's Authorware 'supports AICC-compliant data tracking and IMS content metadata to ensure the courseware can be reused and tracked by learning management systems'.

How much metadata is necessary?

The type of search options preferred by end users will influence the metadata requirements. If end users prefer to use key word searches it may not be worthwhile collecting say 'educational' metadata.

Research done by Backroad Connections published in January 2001 reports:

> 'The core of any resource database is the description of the actual resources. Some of the decisions about what information to include in descriptions of individual resources will be determined by the structure of your database. However there will typically be a general description field and you should create guidelines for staff cataloguing resources to say what information should be included in descriptions.'

As part of the research conducted by Backroad Connections, it was suggested that users will often have 'a systematic approach to deciding if a particular resource meets their needs'. To help identify the suitability of a resource users may be interested in the following resource information:

- Information about the required literacy, numeracy and/or computer skill levels
- What pedagogical approach the resource takes or assumes
- The completeness of the resource (ie is it stand alone or does it require the use of auxiliary resources?)
- Whether the resource is designed to support specific modules, units of competency etc
- The nature of the resource (ie is it print, online or video?)
- Any technical specifications regarding the delivery media (ie does the resource need to be embedded in an LMS?)
- A clear indication of the currentness of the resource (ie is this the latest version?)

The authors of this paper recently asked several practitioners if they would like to use a search facility like the one in iLumina, which provides much of the information mentioned above. The following responses were given:

> 'Eeek, first impressions – I don't like the interface. Wow, the advanced search is pretty detailed – seems to work well. I can imagine that most lecturers would be slightly intimidated by this level of complexity and would also be unlikely to know what half of those things are (eg media types, learning resource type), but for those that are confident users the advanced search looks pretty powerful and potentially timesaving. The higher-ed speak is a bit off-putting though. However, all that aside – this looks pretty amazing but I suspect a bit beyond what "average" lecturers would be comfortable with.'

> 'I found this far too complicated so if I thought this the average punter would be overwhelmed. So I would stick with my earlier suggestion - keep it really simple as the Toolbox Repository example.'

The gathering of metadata is an expensive exercise. Systems such as the iLumina example, gather a lot of metadata (based on IMS standard) to facilitate their range of search options. They limit costs by:

- making only a few elements compulsory – <title> and <description>
- making some automatic – <contributor>
- designing intuitive interfaces and educating users through point of need help screens.

They do not use all the IMS metadata elements and give the following reasons for their selective use:

- Many of the **Educational** elements appear not particularly well-defined or useful for *our* contributors and end users
- Some are not cost-effective unless gathered automatically
- Others, such as **Rights**, are inadequate for their implied task
- A few, like **Annotation**, would be better included in non-cataloguing metadata records.

Millea informs that, 'When the EdNA Online project first began, the records created held a title, URL and description. After a while it became clear that more information about the resource would be useful, and in fact was necessary for resource management.' This was at a time when the Internet was less sophisticated and searches were chaotic and disorganised. Millea points out that as the Internet has evolved there is a greater need to not only find information, 'but also to find information about the information – how recent is it, who wrote it and its authority'.

Organisations considering a repository should do a 'needs analysis' of the user preferences before deciding on how much metadata they require to facilitate search and retrieval. As Dalziel asked at a recent debate on metadata:

> 'What does the research data show of the actual metadata needs of teachers?
> 1. Google
> 2. key word (1 field)
> 3. use of advanced search features – minimal
>
> Have we really asked them what they want?'

Dalziel stresses that there is an urgent need for more research and demonstrators to determine search and retrieval requirements. Metadata also plays a role in information and rights management. See *To meta-tag or not to meta-tag* for further discussion.

Metadata and granularity

The level of granularity at which metadata should be applied should be determined by specific requirements. Attaching metadata to individual graphics may be advantageous for monitoring workflow or rights management. However, if they are subsequently aggregated into larger objects, and search and retrieval

and rights management are only done at this level then it is at this level that the metadata should be applied. Maxine Brodie, in her presentation at the '*To meta-tag or not to meta-tag'* debate states that in the library system the granularity issue – indexers v cataloguers has never been resolved.

Who should create metadata?

AEShareNet provide members with the software to create metadata for resources as they are added to the system. They also provide guidelines on how to complete the metadata. Smaller repositories may employ a manager (akin to a database manager) who is responsible for entering the metadata of submissions or carrying out edits and updates. In more open systems such as MERLOT individual users create their own metadata by completing forms developed specifically for the task. Guidelines and/or training is imperative to assist with good data capture.

To meta-tag or not to meta-tag

The current discourse on metadata includes the argument why do it at all? James Dalziel who has been actively involved in the COLIS demonstrator project goes as far as to say STOP IT until:

- we fully harmonise our standards
- we solve the problem of quality assurance
- we can truly justify the investment
- we have thoroughly researched what users want.

Otherwise we are wasting time and money on a fantasy. As an alternative to metadata he suggests information exchange within communities of practice including email, newsletters and gossip and automated textual analysis (latent semantic analysis which provides a method for determining the similarity of meaning of words and passages by analysis of large text corpora).

Metadata is not just about search and retrieval. Some other areas to consider include:

Knowledge management

Jon Mason points out that 'knowledge management' is increasingly important. He quotes Standards Australia:

> Knowledge management…'is a multi-disciplined approach to achieving organisational objectives by making the best use of knowledge. KM focuses on processes such as acquiring, creating and sharing knowledge and the cultural and technical foundations that support them. The aim is to align knowledge processes with organisational objectives.'

He also points out that the information economy is in its infancy and metadata is integral to it. However, the requirements and benefits of this for the VET sector are still unclear.

Administration

EdNA extended their set of elements to deal with administration requirements. 'Some internal administrative metadata elements for resource management.…include edna.audience [includes values for audience, sector], edna.approver [admin], edna.categorycode, edna.entered, edna.indexing [admin, level], edna.review, edna.reviewer, edna.version.'

Relationships

Related information such as 'other objects by this provider' or 'other objects on this topic' or 'reviews on this object' can be used to value-add to the search and retrieve process.

AEShareNet provides browsers with a list of NTIS codes for qualifications that a resource is relevant to whereas the Toolbox Repository will only list the qualification in which the resource currently resides or was created for.

To provide related information such as that in AEShareNet, the metadata must be collected and applied by someone with the experience and knowledge to do it properly. However, in some instances, such as work by the same provider, the relationship may be created automatically using software.

Separating content-structure-presentation

Metadata in the form of mark up, for example the IMS Question & Test Interoperability (QTI) specification – is a mark up schema for question information making it easy to edit or reformat for different presentation requirements. Another example would be MathML or the Connexions Mark-up Language (CNXML) being developed at Rice University <http://cnx.rice.edu/cnxml/0.4/> .

Enabling data interchange

Meta-metadata – tells a system which metadata standard has been used to facilitate mapping. Several systems may be used together to facilitate data interchange such as the use of V-Card to store staff details.

Organising knowledge

The iLumina example began by developing extended library services such as collection display, review and ratings. The collection option gathers together resources with a common topic. A collection-level metadata record facilitates the collection level discovery. EdNA has recently improved its search options by using the VOCED thesaurus to create relationships between resources. When users select a resource they are provided with a list of related resources.

The Metadata Encoding & Transmission Standard (METS) metadata provides the following elements to assist with knowledge organisation:

File groups - The file group section lists all files comprising all electronic versions of the digital object. File group elements may nest, to provide for subdividing the files by object version.

Structural map - The structural map is the heart of a METS document. It outlines a hierarchical structure for the digital library object, and links the elements of that structure to content files and metadata that pertain to each element.

Deciding the metadata requirements of an organisation then, requires looking further afield than simple search and retrieval. There is also a need to consider interoperability issues with other systems such as Learning Object Exchanges, Content Learning Management Systems, Product catalogues, Staff and Student records or management systems within an organisation.

Vocabularies and thesauri

Carol Fripp suggests that having a common schema for describing resources within the VET sector would assist interoperability, especially in relation to AQTF codes and NTIS levels. Gary Putland raises the issue that using metadata to categorise/contextualise resources may restrict their reusability since resources are often reused in completely different contexts and for different learning objectives. However, practitioners who teach in a specific topic may feel more confident scanning a repository for resources associated with that topic only, as opposed to doing a generic search on a concept such as 'communication skills'.

The Le@rning Federation is 'developing a schools-focused thesaurus to describe educational terms and a curriculum organiser to enable states and territories to access their content via their curriculum frameworks, if they so wish'. (Curriculum Corporation & education.au limited, 2002)

Future directions

The process of creating controlled standard vocabularies for the description of learning objects is an ongoing process. The IEEE LOM specification was approved as a standard in June 2002; however, work still continues focussing on implementation, collaboration with other standards and maintenance and evolution. The EdNA Metadata standard has been established for some time and successfully implemented but it is currently undergoing a review.

A Metadata Reference Group under the authority of the AICTEC Standards Sub-Committee is intended to inform and progress the national agenda for the consideration and development of standards within Australia and to participate on international debate on standards and application profiles. The following are an example of the issues Professor Neil McLean (Director of IMS Australia) has identified for discussion:

1. Application profiles are now fairly widely deployed but interoperability between them remains a significant issue.
2. There needs to be a 'reality –check' on just how much metadata is really needed for primary functional purposes.
3. Consideration needs to be given to mapping issues between schemas and vocabularies.

Key points for consideration

1. Current standards have developed to an encouraging level of stability but as Friesen et al report much of the work done has focussed on syntactic and systems-level interoperability and less emphasis has been paid to semantic interoperability. For instance, the Dublin Core element *Type* describes the actual media type, such as 'text' or 'audio' and is not indicative of the 'learning' type such as 'activity' or 'assessment'. EdNA's curriculum vocabulary defines educational application: 'lesson plan', 'online project' etc while the IEEE LOM elements provide values for both media format and educational application.

   How will VET practitioners search a repository and what type of metadata is required to support these searches?

2. Basically an organisation could waste a lot of money creating unnecessary metadata or they could find themselves restricted or non-competitive in the future because of their lack of it.

   Is there a need to develop a national metadata application profile for the VET sector and what kind of metadata should be the minimum requirement?

3. It is commonly understood that objects should be self-contained and not reliant on other material in order to make sense. This is also a criterion for compliance with the SCORM (Shareable Content Object Reference Model) specification. However, at the search stage it may be of interest to the user to see related content. For instance you may wish to see more objects developed by the same author/organisation, or other objects on the same topic.

   How can metadata be structured to allow users to see related content?

4. Organisations in the VET sector may best inform themselves by observing progress in similar industry sectors such as libraries and book publishers. For instance, the Metadata Encoding & Transmission Standard (METS) is an initiative of the Digital Library Federation. On their website they comment that, 'For internal management purposes, a library must have access to appropriate technical metadata in order to periodically refresh and migrate the data, ensuring the durability of valuable resources'.

Is this concept also applicable to repositories of digital learning objects.

5. Some sectors such as school curriculum and libraries use vocabularies and thesauri to help categorise resources. This makes it easier to locate specific resources within the catalogue, but requires extra effort on behalf of the cataloguer.

   Should we have set vocabularies and thesauri for categorising VET objects?

Guidelines for digital repositories

The development and implementation of standards, applications and services is an integral part of the emerging knowledge economy. In the interest of interoperability there is a need for a set of standard guidelines for the developers of learning object repositories. However, it is the opinion of the authors that these guidelines should be used to guide appropriate development, and not stifle the creation, of learning object repositories.

In recent years several organisations have begun working on guidelines and technical specifications for the design and development of both learning objects and learning object repositories, some of these guidelines will be examined more closely here as a starting point for the development of a set of VET specific guidelines.

Existing guidelines

Much work has been done both in Australia and overseas to establish technical standards and guidelines for learning object repositories, with most of this effort devoted to the establishment of metadata standards. In the education domain Education Network Australia (EdNA) has developed a metadata standard that is based on Dublin Core and is consistent with Australian Government Locator Service AGLS for their learning resource repository. Other standards specific to education include The Authoring and Distribution Networks for Europe (ARIADNE) and The Instructional Management System (IMS) project in the USA.

The Le@rning Federation has put significant work in the development of a set of technical specifications for the development of learning objects. ANTA has also provided a set of specifications for the development of the Australian Flexible Learning Framework Toolboxes. Both of these specifications make reference to the EdNA Metadata Standard, v1.1.

The Le@rning Federation's Specifications address the following areas:

- Educational soundness.
- Rights management.
- Accessibility.
- Content development.
- Metadata.
- Web services.

Each one of these areas will be covered in the following pages in relation to the technical specifications and associated VET specific considerations.

Educational soundness

The Le@rning Federation describes educational soundness as 'the capacity of online curriculum to successfully promote student learning'. This would seem to

be a concise and adequate definition and is consistent with The IEEE's Learning Technology Standards Committee (LTSC) widely accepted definition of a learning object as 'any entity, digital or non-digital, which can be used, re-used or referenced during technology-supported learning'.

The Educational Soundness Specification is underpinned by the following four principles:

- learner focus
- integrity
- useability
- accessibility.

These specifications are covered in detail in the Educational Soundness Specification: Version 2.2 available online at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/educational_soundness_specification_v2_2.pdf.

Teaching and learning approaches

In preparing guidelines for the development of toolbox learning materials, ANTA notes that there 'is the need to exhibit effective teaching and learning approaches' and that toolbox materials should possess the following qualities:

- adopt a learning model reflecting an active, constructive role for learners
- include learning activities that engage the learner
- encourage active learning of the subject rather than mere knowledge acquisition
- learning settings that encourage meaningful communication and interaction
- content resources which are visually attractive and motivating
- representation of authentic and real life settings.

The importance of context

Higgs et al (2003), in their literature review of the instructional issues relating to learning objects, identify the contextualisation of learning objects within the VET sector to be a major pedagogical problem.

However, as has already been noted, arguments for context neutral learning objects do not appear to be 'holding water' in the educational sector, with a number of authors and organisations maintaining that part of the uniqueness of the VET sector is the provision of authentic workplace examples and scenarios.

WestOne Services (2002) state that learning is inextricably linked to real-life situations and that learning material should therefore include scenarios and instances that the learner can relate to.

To support the inclusion of context, the desired characteristics for Toolbox learning materials state that they should include 'representations of authentic and real-life settings'. Similarly the Le@rning Federation's 'educational soundness' specification states that:

'Online content will have learner focus when it has purpose, meaning and relevance for the learners and it:

- enables learners to interact with, organise, represent, interpret and manage the process of learning and the information flow
- makes explicit the intended process/es of learning
- and contextualises student learning by making connections with prior learning and likely future learning.'

There appears to be a definite need to include context as part of the guidelines in developing suitable objects for a VET repository, and it is suggested that perhaps context needs to be considered as a fifth principle supporting the educational soundness of objects in a VET repository.

Rights management

The Rights Management specification developed by the Le@rning Federation has been based on national and international best practice and is designed to protect copyrighted material from unauthorised use as specified under the Copyright Act 1968.

It is based on the four principles of:

- equitable rights licensing
- authoritative rights branding
- flexible rights trading
- legal rights compliance.

A full specification of The Le@rning Federations Rights Management specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/rights_management_specification_v1_2.pdf

What is most important within these specifications is the ongoing work being undertaken by The Le@rning Federation on a range of initiatives in digital rights management. These include:

- developing licensing models for intellectual property based on emerging multimedia licensing best practice
- formulating a clear and extensible rights management information model
- using the Open Digital Rights Language (ODRL) as a standard vocabulary for digital rights metadata
- using a Digital Object Identification (DOI) numbering system described within EdNA and IMS metadata standards.

It is suggested that the Australian VET sector follow these developments and assess their suitability.

Accessibility specifications

The accessibility specification developed by the Le@rning Federation conforms to Commonwealth laws regarding accessibility and aligns itself with international best practice. The specification consists of the following eight principles:

- legislative compliance
- appropriate learning object design
- authoring tool design and operation that supports accessibility of content
- access device independence
- customisation based on user preferences
- provision of contextual and orientation information
- provision of accessibility rating of content
- provision for specification of a level of telecommunications and hardware/software compliance.

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Accessibility_Specification_V1_5.pdf

In recognition of the growing need to make online resources more accessible, The National Office of the Information Economy's (NOIE) Online Council has recently agreed to the adoption of the World Wide Web Consortium (W3C) Web Content Accessibility Guidelines as the common best practice standard for all Australian government websites. Since 2002 this has also been the case for all Flexible Learning Toolboxes.

Through meeting the seven checkpoints the Le@rning Federation's specification also meets the standards set by W3C, as well as adherence to the Human Rights and Equal Opportunity Commission (HREOC) under section 67(1)(k) of the Disability Discrimination Act 1992 (DDA).

Any guidelines developed for a VET learning object repository would also need to be accessible within the requirements of the Australian Qualifications and Training Framework Standard 2 which states: 'An RTO must identify and comply with Legislation on anti-discrimination, equal opportunity, racial vilification and disability discrimination.'

Technical specifications for content development

TheLe@rning Federation defines a learning object as 'a digital resource facilitating learning experiences related to a particular educational purpose' and has provided a series of technical specifications for learning objects based on the following principles:

- Accessibility
- Useability
- Interoperability
- Flexibility
- Durability

- Scalability.

The current specification provides information on the learning object model as containing resources, organisations, and metadata. The specifications continue to describe the packaging and structure of learning objects as well as a detailed specification of the content model requirements for learning objects and permissible media types and formats.

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Tech_Specs_Content_Develop_V3_0.pdf

In preparing the technical requirements for Toolbox development ANTA notes 'In the interests of portability and flexibility, the Toolbox online learning materials should be capable of being delivered on the internet using a web browser and should be designed for ease of use and accessibility to the maximum number of target users. This specification is consistent in all major respects with the Preferred Standards Recommendations developed in 2000.'

A full copy of the specification is available at http://flexiblelearning.net.au/toolbox/toolbox5/workshop/technical_guide.doc

It is suggested that the technical specifications provided by both ANTA and The Le@rning Federation form the basis of acceptable guidelines appropriate to the VET sector with the inclusion that all technologies used must adhere to international standards.

Metadata

The Le@rning Federation has spent much time and effort in recent years developing a Metadata Application Profile to support the access, search, selection, use, trade and management of learning objects. This application profile is based on international metadata standards[5] and supports best practice.

The Metadata Application Profile supports the following principles:

- adoption of international metadata standards that are compatible with other Australian education sectors without compromising the goals of Australian school education
- adoption of metadata standards that do not compromise school education systems and sectors in achieving their own educational priorities
- recognition that optimisation of the learning value of digital learning objects is fundamental in establishing interoperable metadata specifications for The Le@rning Federation
- recognition that metadata needs to support the access, search, selection, use, trade and management of learning objects

[5] Dublin Core Metadata Element Set, v1.1; EdNA Metadata Standard, v1.1; and IEEE learning object Meta-data Standard, draft v6.4

- recognition of the tension between the processes involved in the international and national standards initiatives.

The Le@rning Federation's Metadata Application Profile has been specifically created to support not only the search, retrieval and use of learning objects, but also to support a range of repository management issues including:

- management of files and learning objects
- description of the educational purpose and value of learning objects
- technical interoperability between information systems using learning objects
- management of the digital rights associated with learning objects
- inclusive access to learning objects.

Within the Application Profile, metadata elements are grouped into the following five categories:

- **Management**: groups the information that describes the digital asset as a whole and its management.
- **Technical**: groups the technical requirements and characteristics of the digital asset.
- **Educational**: groups the educational and pedagogical characteristics of the digital asset.
- **Digital rights**: groups the intellectual property rights and conditions of use for the digital assets.
- **Accessibility**: groups the accessibility characteristics of the digital asset.

From a pedagogical perspective the application profile supports description of the educational integrity of a learning object. The metadata includes elements for describing:

- the object's curriculum topic
- the potential learning outcomes supported by the object
- teaching methods for presenting the material
- the intended audience for the object.

A full copy of the specification is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Application_Profile_1_2.pdf

The EdNA Metadata Standard 1.1 is based on the Dublin Core Metadata Element Set (DCMES) and is consistent with Australian Government Locator Service (AGLS) and is being used in both the Flexible Learning Toolboxes and the Australian Flexible Learning Framework Toolbox repository. It is important to note however, that the current EdNA metadata standard was primarily intended to facilitate discovery of online educational resources and not intended as a standard for learning object repositories.

The EdNA Metadata Standard 1.1 is under review and a working group is producing Version 2.0 of the Standard that will include more education-related elements in line with developments within the Dublin Core Metadata Initiative.

A full copy of the specification is available at http://www.edna.edu.au/metadata/documents/edna_metadata.pdf

Specification of common metadata within the Australian VET sector will ensure a high degree of semantic interoperability. This may require the development of a VET specific application set (or perhaps a VET specific application set within a much broader Australian/international education application set).

A suggested model for the application set may be one that has at least two layers. The first could be based on an existing application set such as that developed by the Le@rning Federation, allowing for a high level of interoperability, with a second layer containing industry specific categories.

The quality and completeness of metadata is another important issue that needs to be addressed within the guidelines, and whilst the EdNA metadata standard is being used quite broadly, currently there is no agreement in the sector about minimum requirements for metadata required for a specific resource. This means that the metadata applied to a resource may differ from organisation to organisation. This potentially poses problems for interoperability across different systems if used on a national resource sharing level between one or more sectors or organisation.

The Le@rning Federation Metadata Application set uses different metadata associated with educational content depending on the quality assurance status of that content. Within the Exchange, states that influence metadata are:

- **Draft status:** Educational content is assigned ‘draft status’ when it is first uploaded to the exchange by educational content developers.
- **Approved status:** Content is assigned ‘approved status’ when it has satisfied all requirements of the quality assurance process.
- **Published status:** Content is assigned ‘published status’ when it is made available for export from the Exchange to the education systems.

The recording of status is mandatory within the specifications.

As content progresses through the content life cycle, more metadata is added, and different metadata elements are mandatory depending on the status of the content within the quality assurance process.

The full specification of Metadata Application Profile Mandatory Elements is available at http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/Metadata_Mandatory_Elements_1_1.pdf.

In viewing the specification, it is important to consider the minimum amount of metadata that would be required for a learning object repository within the Australian VET context, and the responsibilities associated with the collection and maintenance of that metadata.

Web service specification

The Le@rning Federation's Web Service specification defines a web service for interacting with the Exchange repository of learning objects. The web service provides a simple programmatic interface allowing client systems to discover and download metadata and learning objects from the Exchange.

The specification is based on the following principles:

- Simple discovery of learning objects, including
  - Ability to discover new learning objects
  - Ability to see aggregation relationships between discovered learning objects
- Simple download of aggregated learning objects
- Use of standard metadata and learning object packaging technologies.

The web service uses a Simple Object Access Protocol (SOAP) consisting of four operations:

- Query learning object
- Download learning object
- Retrieve learning object metadata
- Test connection.

The full specification of Web Service Specification is available at: http://www.thelearningfederation.edu.au/repo/cms2/tlf/published/3859/docs/SOAP_Specification_V0_4.pdf. This specification is in draft form and is currently under review.

In developing guidelines for VET learning object repositories, it is important to consider the interface design elements and how the user will interact with these commands and environments. The interface should be kept simple and easy to use with suitable provisions for a help facility.

Key points for discussion

1. The Le@rning Federation has put significant work in the development of a set of technical specifications for the development of learning objects. ANTA has also provided a set of specifications for the development of the Flexible Learning Toolboxes.

   Do the Le@rning Federation's Specifications provide a suitable framework for the development of a set of VET specific guidelines for learning object repositories? And what are some of the issues not covered in these guidelines that are relevant to the VET sector?

2. Tim Hand from OTEN has suggested that it may be possible to categorise learning objects as belonging to one of the following types:
   - asset objects
   - software code/applets etc
   - information objects
   - learning objects (discrete learning outcomes/competency)
   - simple learning sequence (combined object)

- assessment/activity object
- context object
- learning design/activity objects
- adaptive (where content is contributed to the object shell).

Are these categories fully inclusive of the possible types of learning objects and should these be built into any VET specific guidelines?

3. Some form of advertising is required to raise teacher awareness of available repositories, especially those at a State or National level. Newsletters run by repository managers can assist busy teachers by announcing new resources and sharing discussions and feedback on object use. The specifications mentioned in this section do not include marketing and promotions or user training/professional development.

   In developing guidelines for the VET sector, should these be included as a tool for improving acceptance and uptake of repositories?

4. Most learning object repositories are stand alone. That is, these repositories function a lot like portals in that they contain a web-based user interface, a search mechanism, and a means of retrieving a learning object. The specifications mentioned in this section are based on a central repository system which would most likely be accessed from a single portal.

   Are these specifications also applicable to distributed repositories? Are strict guidelines necessary for smaller intraorganisational repositories?

Appendix A

Learning objects

As early as 1969 Gerard envisaged that educational material could be broken down into small components that could be combined, like Meccano, into customised learning (Gibbons, Nelson & Richards, 2000). The term *learning object* is believed to have first appeared when Wayne Hodgins included it in the name of a working group in 1994. Around the same time NETg trademarked the term NETg learning object (NLO) to describe its 'object-based strategy for developing and delivering learning content'. (Barron, 2000)

Early literature conceptualised learning objects using metaphors such as Lego blocks. However, as Wiley (2000) and Higgs et al (2003) point out, this approach is too simplistic and a better understanding of the concept can be found through exploring practical applications and their common characteristics.

Definitions

Currently there is no common definition of the term *learning object* and there is a growing awareness that a common definition may be inappropriate. As the following examples demonstrate objects will ultimately be defined by the requirements of the systems in which they are employed and the roles they are required to play. The following learning object definitions have been taken from standards organisations, current literature and object repository initiatives.

1. The IEEE's Learning Technology Standards Committee (LTSC) defines learning objects as 'any entity, digital or non-digital, which can be used, re-used or referenced during technology-supported learning'.

2. Stephen Downes, in his article Fast Buck Artistry (2002) suggests that the difference between a learning object and a textbook chapter is that one is digital and the other is physical. According to Downes, 'All the tricky bits, all the alphabet soup, that we run into in the world of learning objects have their exact counterparts in the world of libraries'. Thus 'learning object = book (or more precisely, book chapter, or journal article) learning object repository = shelf metadata repository = card catalogue metadata = card (in a card catalogue) learning management system (LMS) = reading room (or classroom, depending on the LMS) learning content management system (LCMS) = librarian (or some other means of locating content)'.

3. TAFE Frontiers 'Creator to Consumer' digital publishing research project provides the following guidelines. They use the term Dynamic Learning Elements (DLE).

   'A DLE would normally be a *section* of a work and would be the smallest granular component of a learning resource. Its structure and content

would be determined by the rules within the training package, subject or curriculum framework, but it must have ten core ingredients.

The ten core ingredients that make a section of work considered a DLE consist of two groups. At the design level, there must be five key conceptual elements, and in describing the resource for the online environment, there must be five key composite metadata elements.

Key conceptual elements

- **Aim**: the resource has been designed, or has been selected, with a specific learning aim in mind, of the teacher or the learner.
- **Process**: there is a defined process or set of learning processes which the resource is designed to facilitate. These must be specified in the description of the element and may be: experiential; conceptual; critical; or transformative processes.
- **Assessment**: the learning outcome can be evaluated by the learner, a peer, the teacher, or through a collaborative assessment process.
- **Pathway**: the resource leads the learner to a follow-on activity or resource which may be learner initiated, teacher-recommended, instructional design-prompted (from within the resource itself) or by virtue of a negotiated process.
- **Framework**: the resource sits within a curriculum or subject framework which defines the rules that govern the use of the resource.

Key composite metadata elements

- **Discovery**: as much descriptive data as possible to make the resource discoverable through library and other resource locating tools. For example, course descriptions, subject headings, learning levels, accredited outcomes and so on.
- **eLearning**: the information required to make the resource compliant with Learning Management Systems, for either direct use (eg an interactive object) or for referencing (eg a set of instructions for a specific action-based piece of learning). This set of data also includes descriptions of the five conceptual elements which help inform other curriculum developers how the content can be best adapted to other learning environments.
- **Copyright**: the ownership and rights information to inform Digital Rights Management Systems and/or users directly of what is required to observe the legal responsibilities for using the content.
- **eCommerce**: the information necessary to facilitate a commercial transaction.
- **Rendering**: the data elements necessary to inform formatting software how to render the descriptive elements about a resource, or the resource itself, into other formats for access and use by the learner.'

4. James Dalziel from his experience on the COLIS (Collaboration Online Learning and Information Systems) Demonstrator project suggests that 'learning objects (as currently understood) should be divided into three "tiers" as follows:

    - Digital assets: the lowest level of files such as text, HTML, images, etc. These files may be static, or dynamically re-useable (in the sense that their operation may be adapted for different contexts or user requirements - such as flexible Flash exercise "shells", or multiple output format rendering via Content Management System functionality for HTML, print, PDAs, etc)
    - Learning objects: learning content which has stand-alone educational value (often associated with a single competency/objective/outcome/etc), based on one or more digital assets
    - Learning activities: the highest level - based on activities and tools such as discussion groups and chat rooms, which may incorporate one or more learning objects.

    Given this structure, "learning objects" may be defined more narrowly as follows:

    A learning object is an aggregation of one or more digital assets, incorporating metadata, which represent an educationally meaningful stand-alone unit". (Dalziel, 2002)'

5. The CAREO (Campus Alberta Repository of Educational Objects) is a searchable, web-based collection of teaching material for educators. The CAREO project defines learning objects to include 'simulations, tutorials, drill and practice modules, content databases, multi-media exercises'. It also goes beyond the area of curriculum development to include 'administrative objects such as calendars and quiz programs', research-related 'items such as discussion papers and research results', and also 'content creation tools such map makers, database tools, graphics, animation tools'.

6. Queensland TAFE has recently added some learning objects to AEShareNet. In the promotional material announcing it, users are to directed to a website for more information on learning objects (http://www.eduworks.com/LOTT/tutorial/learningobjects.html). Within this site the following definition is provided:

'Reusable learning objects represent an alternative approach to content development. In this approach, content is broken down into chunks. From a pedagogical perspective, each chunk might play a specific role within an instructional design methodology. The requirements for each chunk are:

- Each chunk must be able to communicate with learning systems using a standardized method that does not depend on the system

- What happens within a chunk is the chunk's business.
- How a learner moves *between* chunks is controlled by the learning system.
- Each chunk must have a description that enables designers to search for and find the right chunk for the right job.'

7. Ron Oliver (2001) discusses objects in relation to the Flexible Learning Toolboxes as follows:

   'Reusable learning objects are now being seen as the fundamental components and building blocks of online learning courses. A learning object is any entity, be it digital or non-digital that may be used for education and training (IEEE, 2001). In the context of online learning, these objects take such forms as Web pages, PDF documents, database applications, animations, Java applets, PowerPoint presentations and QuickTime movies. In the context of the Flexible Toolboxes, learning objects take a broader context and form and are defined more in terms of their educational properties, for example as learning elements, modules and assessment items.'

   WestOne Services (2002) also point out that defining objects in terms of their educational properties is more meaningful for teachers and instructional designers than the technical definitions applied by standards organisations. A comparison is shown in the table below:

Technical	**Logical**
'**2.1.1.1 Assets** Electronic representations of media, text, images, sound, web pages, assessment objects or other pieces of data that can be delivered to a Web client.'	Individual items such as graphics, charts and diagrams.
'2.1.1.2 Shareable Content Object (SCO) Represents a collection of one or more Assets…A SCO represents the lowest level of granularity of learning resources that can be tracked by an LMS using the SCORM Run-Time Environment.'	Support resources such as case studies, examples, articles, scenarios etc. Sections of generic content that could be tweaked and reused – manual handling rules, communication skills, how to operate a PC etc.
'**2.1.1.3 Content Aggregation** A content aggregation is a map (content structure) that can be used to aggregate learning resources into a cohesive unit of instruction (eg course, chapter, module, etc).'	Self-contained content that meets specific learning objective(s) – learning object, lesson, module, unit, course.

8. Williams, Boulton, Louka and Schauder (2002) offer a 'pragmatic definition of learning objects as whole courses and components of courses which are deemed reusable in one or several contexts.' For many institutions this may be a good starting point, where large chunks of currently available material can be quickly made available by adding metadata and publishing to a shareable library. This process has the potential to reduce time spent researching and producing content, thus facilitating rapid creation of new value-added learning content (Longmire, quoted in Williams et al, 2002).

Characteristics of learning objects

Research by Higgs et al (2003) found the following to be considered essential characteristics of learning objects:

Independent - learning objects are discrete and coherent chunks of information, activities or assessment, which are self-contained in that they can contain a complete learning sequence, and don't rely on other material in order to make sense.

Shareable/ Reusable - learning objects are small stand alone, reusable components that can be assembled to provide resources in various learning environments, ie content developed in one context being transferable to another context. It is this notion of shareability which is fundamental to leveraging any advantage in using learning objects.

Interoperable - Objects must be interoperable that is: content from multiple sources must work with different learning systems. In order to do this they must be designed to conform to various standards.

Instructional value - In order to be defined as a learning object there must be some intrinsic instructional value. An learning object is not just a knowledge or information object. It should result in a complete learning sequence, objective, skill or competency (this is a granularity issue - in VET in Australia a learning object might be loosely matched against a performance criterion of a training package element of competency).

Discoverable - Objects must be able to be found. This usually entails tagging them with appropriate descriptive metadata that will focus on linguistic semantics.

They also identified two more contentious properties for consideration.

Granular - Always the most difficult consideration for which there is no definitive requirement. Currently we need to be pragmatic and accept that there may need to be a range from a single image file to an entire course.

Context - In order to maximise their reusability, learning objects are required to minimise the amount of information specific to a given context. However this is often difficult; again we need to accept some latitude in that learning objects can

include context-related information either within the object or by some external association to it.

Learning objects v information objects

Longmire (2000) suggests that reusable learning objects should be ‘able to satisfy a single learning objective’. This view is also reflected in the research by Higgs et al (2003) mentioned above. However, many items such as charts or graphics while not instructional on their own are highly reusable. Terms such as *information object* or *content object* or *asset* have been used to describe content that supports an educational purpose but is not in itself able to satisfy a learning objective.

Whether a repository contains only objects that are self-contained learning units, information objects, or a combination of both should be determined by the requirements of the end users and specific implementations as opposed to trying to comply with some overarching definition. It may be that the nature of content in a repository will evolve as the object paradigm matures and practitioner use becomes more clearly defined.

It may be argued that definitions are necessary for quality control or interoperability. Guidelines for quality should apply irrespective of the shape, size or nature of an object. Interoperability is determined more by technical infrastructures and properties such as run-time code, content packaging, metadata schemas, technical standards for development and content mark up.

Appendix B

Metadata standards

One of the first metadata standards for digital information to be widely adopted was the Dublin Core Metadata Element Set (DCMES). The Dublin Core Metadata Initiative is an open forum that develops standards for online metadata. The standard has a core set of 15 elements that cover a broad range of domains.

Many domain specific standards organisations adopted the Dublin Core set and then added elements to cater for their particular industry information. One example is the Australian Government Locator Service (AGLS). AGLS was developed in late 1997 as the resource discovery metadata standard for Australian governments and was endorsed for use by all levels of government in Australia in November 1998. The AGLS metadata standard is based on Dublin Core and consists of 19 elements - the 15 DC elements plus an additional four that were considered necessary in the Australian government context. The Dublin Core initiative has active participation and promotion in over 20 countries in North America, Europe, Australia and Asia.

In the education domain Education Network Australia (EdNA) developed metadata that is based on the Dublin Core and consistent with AGLS for their learning resource repository. Other standards specific to education include The Authoring and Distribution Networks for Europe (ARIADNE) and The Instructional Management System (IMS) project in the USA.

ARIADNE and IMS collaborated with a working group under the IEEE Learning Technology Standards Committee (LTSC) to develop the learning object metadata (LOM) standard. The IEEE/LOM version 6.1 WD (working draft) has been adopted by both ARIADNE (Educational metadata recommendation version 3.1 (May, 2001) and IMS (Learning resource metadata specification version 1.2 (June, 2001).

The IMS Final specification Version 1.2 contains only a few minor variances from the LOM standard.

The IEEE LTSC has become the main source of metadata standards for most eLearning organisations. In their article*, Everything you wanted to know about standards but were afraid to ask,* Hodgins and Conner explain:

> ‘Over many years, in its role as one of the world's accredited standards bodies, the IEEE LTSC has created critical open and accredited standards using a very robust consensus-based model. The IEEE LTSC has also recently initiated the move of this work to the full International Standards Organization (ISO) standards by establishing ISO Joint Technical Committee 1 (JTC1) Sub Committee 36 (SC36) on Learning Technology.’

In August 2001 the IEEE LTSC, the Dublin Core Metadata Initiative, and IMS met to discuss 'the development and application of modular interoperable metadata for dissemination to the global education and training communities'. This is a clear indication of how the various organisations are continuing to work together, as opposed to competing with each other. The resulting standards are subsequently being adopted by eLearning providers, for example the Canadian Core Learning Metadata protocol (**CAMCORE**) is a sub-set of the IMS Specification.

Where different metadata standards have been adopted interoperability may still be achieved by using software to create a mapping between the elements as shown in the table below.

Dublin Core element	**IEEE/LOM element**
Contributor	Lifecycle.Contributor.Entity [IEEE /LOM 2.3.2]
Coverage	General.Coverage [IEEE /LOM 1.7]
Type	Educational.LearningResourceType [IEEE/LOM 5.2]
Subject	General.Keywords [IEEE/LOM 1.6] and/or Classification.Keywords [IEEE/LOM 9.4] and/or Classification [IEEE/LOM 9] [IEEE/LOM 9.1, IEEE/LOM 9.2.1, & IEEE/LOM 9.2.2.]

However, the IMS Best Practice and Implementation Guide warns that this process does not guarantee that the elements are semantically or structurally equivalent and care should be taken as interpretation may vary between implementations.

General industry trends

The development and implementation of metadata standards, applications and services is an integral part of the emerging knowledge economy. For instance, the new gateway service DP9 (an open source gateway service that allows general search engines, eg Google, Inktomi, etc to index Open Archives Initiative [OAI] compliant archives) will allow Internet access to the metadata contained in some existing public libraries. Similar services are being proposed by the Instructional Management System (IMS) Global Learning Consortium 'to allow applications to search and retrieve resources from both learning object repositories and existing library systems'. (Wilson, 2001) The COLIS (Collaborative Online Learning and Information Systems) demonstrator developed by five Australian universities (Macquarie, Newcastle, Tasmania,

UNE, and USQ) provides a 'testbed' for searching across several repositories, including a public library, from within a learning management system.

Dalziel (2002) points out that many of the current challenges for eLearning have parallels in the library world, which has over a decade of theoretical development we can learn from. Similarly, advancements in the electronic (eBook) sector are relevant and can provide insight into search and retrieval mechanisms. Several online publishers have adopted the Digital Object Identifier (DOI) technology.

The DOI was created in 1998 to provide a common infrastructure for content management. Currently the foundation has over 200 companies using several million DOIs. It is run by a board of members – members are open and international and include 'any organisation with an interest in electronic publishing, content distribution, rights management, and related enabling technologies'.

The DOI itself consists of a prefix and a suffix. The prefix always begins with 10. Unlike a URL a DOI is persistent. It identifies the IP entity (object) itself as opposed to the location where it is stored. It is persistent in that it will remain the same even if the ownership or rights information changes.

TAFE Frontiers in their C-2-C action research project - Digital storage and retrieval – An action research approach (Smart & Fennessy) have used DOIs as part of their metadata for describing objects which they refer to as Dynamic Learning Elements (DLEs). An example is shown below.

DLE Field Name Field Contents

Title The history of nursing research
Publisher TAFE Frontiers
Place of publication Melbourne, Australia
Author Swinburne University
Digital Object Identifier 10.TF/1234567890/VBM589/DLE1
(Consisting of: 10 = DOI, 10 digit number = ISBN, TAFE frontiers Product code and DLE number)
Dimensions 210X175
Edition 1
Edition type Print edition
Format A4
ISBN 1234567890
PDF ISBN 1234567880
Metadata Language CGML
Original Language English
Price $XX
Product Available Yes
Aim To understand the role of research in nursing.
Assessment Activity outcomes and comprehension level, assessed by instructor.
Framework Introduction to Research – Certificate IV Health (Nursing) VBM589
Other related DLEs The purpose of research DOI 10.XXX
Ethical considerations DOI 10.XXY

University and industry groups are creating metadata schemas to represent their domain knowledge and support collaboration and information sharing. Five universities including the University of Queensland in partnership with the Institute of Engineers, Australia (IEAust), the Centre for Mining Technology & Equipment (CMTE) and the Distributed Systems Technology Centre (DSTC) have developed the Australian Virtual Engineering Library (AVEL) (Talmacs, 2000, p. 5). The main objective of AVEL is to improve sharing of information between industry and university researchers. Their metadata is based on the Dublin Core elements.

Another group of Australian universities is working on a metadata system to improve the access to research information in theses and dissertations. Based on the US Networked Digital Library of Theses and Dissertations the Australian Digital Theses project uses nine Dublin Core elements and a small number of qualifiers (qualifiers are applied to an element to make the meaning more specific). These are automatically applied to digital versions of the research resources. (Talmacs, 2000, p. 6)

Similar examples can be seen in the wider business community. The ebXML initiative, for example, provides an XML-based specification for Internet business transactions including a catalogue of 150 common objects such as ‘address’ and ‘exchange rates’. (Rishel, 2001)

Acknowledgments

The VET Learning Objects Repository Project is managed by WestOne Services.

WestOne would like to acknowledge the following contributors to this paper:

Linda Arnold	Resource Generator
Maxine Brodie	Macquarie University
Graeme Brownfield	Office of Training and Tertiary Education
Michael Coghlan	Douglas Mawson Institute of Technology
Les Comley	Resource Generator
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
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

References

Backroad Connections (2001) *Guidelines for Developing Resource Registers*. Available from http://www.flexiblelearning.net.au/accessresource/stage1/guidelines.htm

Barron, T. (2000) *Learning Object Pioneers*. Learning Circuits, Available from http://www.learningcircuits.org/mar2000/barron.html

Dalziel, J. (2002) *Reflections on the COLIS (Collaborative Online Learning and Information Systems) Demonstrator Project and the 'Learning Object lifecycle'*, ASCILITE 2002 Conference Proceedings, ASCILITE. Available from http://www.colis.mq.edu.au/projects/demo/docs/dalziel.doc

Downes, S. (2002) *Fast Buck Artistry,* Stephen's Web*.* Available at http://www.downes.ca/cgi-bin/website/view.cgi?dbs=Article&key=1039643254

Duncan, C. & Ekmekioglu, C. (2003) *Reusing Online Resources: A Sustainable Approach to eLearning*, (Ed.) Allison Littlejohn. Kogan Page, London. ISBN 0749439491

Fripp, C. & Macnamara, D. (undated) *Copyright Management in the World of Learning Objects*, Paper presented at the EDUCAUSE in Australasia conference, Adelaide Australia.

Higgs, P, Meredith, S & Hand, T. (2003) *Technology for Sharing -A research project to inform VET Australia about Learning Objects and Digital Rights Management including systems and metadata to support them.* Flexible Learning Leader 2002 Report, Australian National Training Authority (ANTA).

Hodgins, W. & Conner, M. (2000)*, Everything you wanted to know about standards but were afraid to ask.* LiNE Zine, Learning in the new economy, Available from http://www.linezine.com/2.1/features/wheyewtkls.htm

Gibbons, Nelson & Richards (2000) *The Nature and Origin of Instructional Objects.* r e u s a b i l i t y . o r g. Available from http://www.reusability.org/read/chapters/gibbons.doc.

Gilding, J. & Fripp, C. (2003) AEShareNet: *Reflections on an Innovative Venture to Move Copyright Licensing into the Digital Age*, Australian Library Journal.

IEEE (2000) Institute of Electrical and Electronics Engineers (IEEE). IEEE, Available from http://www.ieee.org/.

Koper, R. Combining (2003) *Combining re-Usable Learning Resources to Pedagogical Purposeful Units of Learning*. Journal of Interactive Media in Education, JIME.

Littlejohn, A. and Buckingham, Shum, S. (2003) (eds) *Reusing Online Resources* (Special Issue), Journal of Interactive Media in Education, (1). ISSN:1365-893X. Available from www-jime.open.ac.uk/2003/1/

Longmire, W. (2000) *A Primer on Learning Objects*, American Society for Training and Development (ASTD), Learning Circuits. Available from http://www.learningcircuits.org/mar2000/printer.html

Oliver, R. (2001) *Learning Objects: Supporting Flexible Delivery of Online Learning*. ASCILITE 2001 Conference Proceedings, ASCILITE. Available from http://www.medfac.unimelb.edu.au/ascilite2001/pdf/papers/oliverr.pdf

Millea, J. (2003) *The EdNA Metadata Standard*. Education Network Australia. Available from http://www.educationau.edu.au/papers/edna_metadata.pdf

Rishel, W. (2001) *Long-Awaited E-Business XML Specs May Spur Online Business*, Gartner FirstTake, Gartner.

Smart & Fennesy (Undated) *TAFE Frontiers in Digital Storage and Retrieval – C-2-C action research approach*. Paper presented at the EDUCAUSE in Australasia conference, Adelaide Australia

Sloep, P. (2003). *Commentary on Diana Laurillard and Patrick McAndrew, Reusable Educational Software: A Basis for Generic e-learning Tasks*, Chapter 7 of: Reusing Online Resources: A Sustainable Approach to eLearning, (Ed.) Allison Littlejohn. Kogan Page, London. ISBN 0749439491. Journal of Interactive Media in Education, (1) Special Issue on Reusing Online Resources. ISSN:1365-893X. Available from http://www-jime.open.ac.uk/2003/1/

Talmacs, K. (2000) *Metadata in the University Environment*, Paper presented at the VALA 2000 Conference, Melbourne.

WestOne Services (Anderson & Mah) (2002) *Keeping It Relevant: An Object Approach to Training Package Content Development that Facilitates Workplace Contextualisation*. HERDSA Conference Proceedings July 2002, HERDSA. Available from http://www.westone.wa.gov.au/portaladmin/PDF/westoneupload/Keeping%20it%20Relevant%20-%20Learning%20Objects%20-%20WestOne.pdf

Wiley, D. A. (2000) *Connecting Learning Objects to Instructional Design Theory: A Definition, A Metaphor, and A Taxonomy.* r e u s a b i l i t y . o r g. Available from http://www.reusability.org/read/

Wiley, D. (2003) *Introduction to Part 2 of Reusing Online Resources: Design Perspectives,* Journal of Interactive Media in Education*,* (1) Special Issue on Reusing Online Resources. ISSN:1365-893X. Available from http://www-jime.open.ac.uk

Williams, Boulton, Louka and Schauder (2002) *Delivering Reusable learning objects from RMIT's New Website – Models, issues and Directions,* Flexible

Models@RMIT Forum, RMIT, Melbourne Australia. Available from http://www.tafefrontiers.com.au/flexible/site/papers/RhysWilliams.pdf.

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