

The trial of learning objects: Exploring the design and delivery of VTE courses with learning objects

Ron Oliver, Mark McMahon

School of Communications and Contemporary Arts
Edith Cowan University

Peter Higgs

TAFE Tasmania

Rose Shum

TAFE NSW

Lisa Wait, Dominic Lou

e-Works Victoria

This paper describes a project undertaken in the Australian vocational training and education (VTE) sector that sought to investigate success factors associated with the design and delivery of courses using learning objects (LOs). The project explored the strategies used by three teachers as they used digital repositories to discover learning objects, and then applied the objects through a content management system to create online courses. The paper reports the factors that were found to influence the online learning settings that resulted and teachers' perceptions of LOs as building blocks for online courses.

Keywords: learning objects, learning designs, vocational education, teacher uptake

Learning objects

The concept of learning objects as reusable digital learning resources is popular among many of the stakeholders involved in elearning. There appear to be many advantages to be gained from being able to reuse digital resources in learning settings and much has been written on the topic of reusability as both a design and development strategy for online learning materials (e.g. Rehak & Mason, 2003). Learning objects have the potential to exert considerable influence on the actions of the vast majority of people associated with elearning including such stakeholders as:

- administrative and financial personnel who look to benefit from the potential costs savings associated with reusing and sharing learning resources
- policy-makers who are interested in the legal and ethical implications of copyright and intellectual property among the shared objects
- instructional designers who need to consider design strategies that facilitate and support sharing and reuse, and
- developers who need to consider appropriate development strategies to ensure interoperability and a capability for use of resources beyond the context for which they are designed (e.g. Downes, 2000; Shepherd, 2000).

Apart from the cost savings that stem from reduced development needs, there is also the advantage of being able to provide learners with access to increased levels of resources. When there are ample reusable resources, teachers and students can select from among those available to choose the most appropriate and the best quality. Reusable resources facilitate the sharing of materials among and between groups, an activity that will likely lead to improved outcomes in terms of providing alternative perspectives and a multiplicity of content sources (Agostinho et al. 2004).

Facilitating the use of learning objects

Much of the current work with learning objects is seeking to explore and provide the enabling systems and processes for teachers to be able to discover and locate online resources that can be seamlessly incorporated into the learning environments they are building (Beetham, 2004). When one examines the

current practice and nature of elearning in general, there are many factors that potentially limit the goals and aims of the learning object movement. For example:

- learning resources come in a huge variety of forms and sizes
- most elearning resources are developed and built for personal and local use without regard for reuse beyond the immediate context
- they are built from a variety of technologies and in a variety of architectures which tend to tie them to particular platforms and operating systems, and
- the resources have often been designed for use in a single setting, with hard links and connections that cannot be easily disconnected if the materials are to be used elsewhere; The resources contain references and descriptions from the local setting which could be out of place if the materials were reused (e.g. Wiley, 2003).

The collection and storage of learning objects

For teachers to be able to use learning objects, they must have access to repositories and databases where the resources have been collected and stored. The repositories need to provide access to resources that are developed in standardised ways and interoperable across many systems. A considerable amount of research has been conducted to explore appropriate ways to develop resources, to gather and evaluate their potential for reuse and to effect their inclusion in accessible collections. Specifications for digital repositories have been an important element in the process to develop standards for learning objects. A digital repository is a collection of digital resources that can be accessed through a network requiring no prior knowledge of the collection's structure. Repositories usually hold many forms of digital resource including their metadata descriptors, although the metadata need not necessarily be stored with the various assets. The specifications for digital repositories that are currently being developed by IMS include object querying and locating functions. Recommended standards include the W3C XQuery (2003), W3C SOAP (2000) the simple object access protocol, and ZOOM (2003), the Z39.50 object oriented model.

Given that there are not large numbers of learning objects in the public domain, it is important for those which are able to be used, that teachers are able to discover them. In recent years a standard set of descriptors (metadata) has been developed to describe and help identify the content of learning objects. (LOM, 2002). The Learning Objects Metadata comprises a wide range of relevant descriptors which are intended to enable learning objects to be accurately described to assist in their choice for reuse. At the same time the metadata descriptors enable objects to be distinguished and provide searchable information about an object's form and content.

There are many, however, who believe that the metadata processes used to describe learning objects are still limited. Even with metadata standards, there are still difficulties to be faced in the discovery of learning objects. Often the metadata applied to resources is inaccurate and incomplete and unable to distinguish between resources (e.g. Brownfield & Oliver, 2003). Another concern is the lack of data that is attached to learning objects that provide descriptions of their learning attributes (e.g. Jonassen & Churchill, 2004). Whilst the metadata provides strong descriptions of the technical aspects of the object, there tends to be very limited information concerning the instructional elements of many of the stored objects and this reduces their potential for discovery and reuse.

The application of learning objects in the Australian VTE sector

Since 2003 the Australian Flexible Learning Framework has been investing heavily in the creation of quality learning resources for the Australian VTE sector. This has included the development of Toolboxes, fully stand-alone online courses for training packages. The Toolboxes have been designed to meet international standards allowing them to be disaggregated easily into shareable learning objects. Some Toolboxes developed prior to 2003 have also been repackaged into reusable forms to enable their use as learning object by VTE practitioners (Oliver et al. 2005). A prototype Digital Repository was developed in 2003 to store and provide access to many thousand of digital resources, learning objects from the Toolbox projects (Brownfield & Oliver, 2003).

The widespread implementation and use of courseware management systems (CMS) in the Australian VTE sector, together with the provision of relevant learning objects in accessible repositories appear to provide golden opportunities for VTE teachers to develop and create online learning resources for their students (Hand, 2004). To that end the Trials of Learning Objects (TLO) was commissioned by the Flexible Learning Advisory Group in 2005 to investigate the capability of existing systems to support teachers' development of quality online courses. While the plethora of technology-supports and digital tools and resources for learning has garnered strong interest among teachers to employ ICT as a mainstream component of course delivery, in practice, the technology-supports and templates often encourage less effective approaches to learning (Britain, 2004). Teachers have been found to still require substantial theoretical and practical guidance in the design of effective e-learning strategies and activities (Littlejohn, 2004). The TLO sought to explore how VTE teachers/trainers could access and use available learning objects and to explore the degree to which current infrastructure could support this form of use. The project also sought to investigate the factors impeding and supporting the development of effective learning settings using these technologies.

Project description

The aim of the TLO was to explore how LOs could be used to create quality learning settings and to discover how best these opportunities might be provided to other teachers in the Australian VTE sector. In particular, the project sought to:

- identify the conditions needed to successfully support teachers/trainers in deploying learning objects in their teaching programs including the level and nature of organisational and technical support required
- examine the pedagogical approaches (method of delivery) employed by teachers/trainers in utilising learning objects in a variety of VTE settings, eg, face-to-face, blended or workplace delivery
- identify the integration/sequencing strategies employed by teachers/trainers in using learning objects within their existing training program and teaching plans, and
- identify the skills and/or professional development activities teachers/trainers required to optimise their delivery using learning objects.

The outcomes from this project were intended to inform the VTE community and possibly the wider education community of the advantages and opportunities of re-using and sharing learning objects and resources and strategies needed to advance such activities among mainstream teaching.

Participants

The project involved volunteer VTE teachers who responded to an expression of interest posted nationally. Teachers willing to develop online courses using LOs were invited to join the project. Project participants were offered both technical and educational support as incentives for volunteering but were faced with quite tight timelines for their involvement. There was considerable degree of initial interest in the project and in the end three teams were considered to be strong applicants and invited to join the project.

Team A comprised a single teacher with substantial experience in the use of ICT in teaching and learning in Tasmania. The teacher had previous experience in the complexities of customising resources and participated in the project to further her interest in learning objects and tools for the assembling of elearning resources. Team B comprised three teachers working in a small company in regional Queensland. The team was experienced in delivering face-to-face training and the project was their first experience in an online learning environment. Team C comprised two people who operated a very small private training company, with no physical 'institute' as such. This team delivered face-to-face training in the food processing industry and had considerable experience in conventional training methods and limited experience in ICT-based delivery.

A technical mentor was appointed to work with the three teams of VTE practitioners. The mentor had extensive technical and pedagogical experience and expertise relating to reuse of digital resources. The mentor provided a number of supports and scaffolds for the participants including:

- the production of a kit/training manual for the participants describing strategies for discovering and accessing LOs
- instructions in the use of an appropriate content management system
- instructions and tips for creating a learning sequence using learning objects, and
- ongoing phone and/or video conference support throughout the project.

Project supports

All participants were provided with access to TAFE Tasmania's Repository (Figure 1), a component of the Learning Object Repository Network (LORN). The objects accessible in this environment include those developed in an ANTA project to support online learning across a variety of qualifications. In particular there were a number of repackaged objects from recent projects, for example the Series 7 Toolboxes. The repository is organized around a powerful content management system, The Learning Edge (TLE). TLE provides search and retrieval functionality as well as an area where practitioners can recontextualise learning objects and materials and finally sequence them in the Content Module area of the Assembler in preparation for delivery. TLE enables users to develop fully conformant resources that can be delivered from the Content Assembler to an IMS/SCORM package for use in any online delivery setting e.g. WebCT, Moodle. Within The Learning Edge, teachers are able to reuse existing content from a variety of sources including their own materials and other materials stored and provided by others. TLE provides the means for teachers with minimal ICT skills to develop comprehensive learning materials for online delivery.

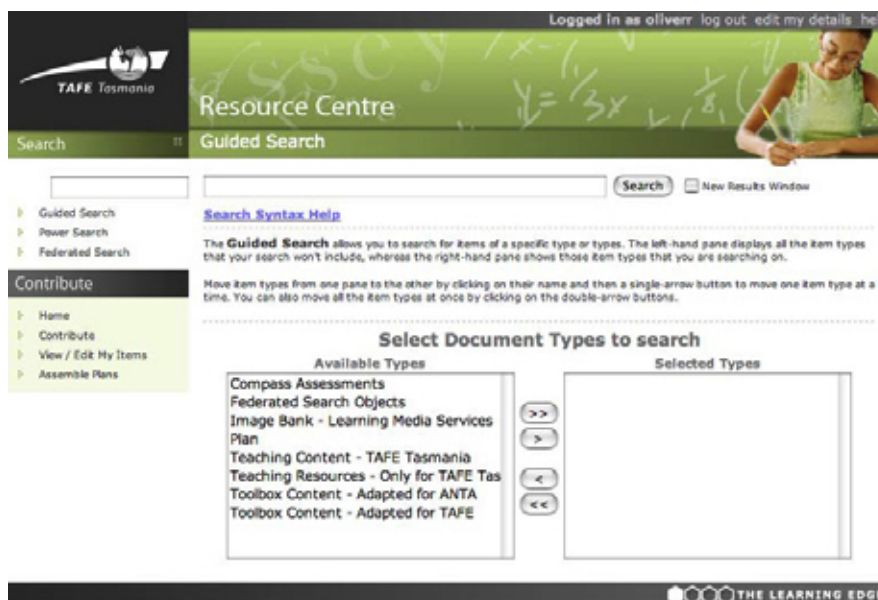


Figure 1: The learning object repositories used in the trials of learning objects

Development of the online resources

The members of the teams were all provided with hands-on training and support to demonstrate the TLE and how it could be used to access learning objects and to implement them in a form that could be delivered by a CMS. The technical mentor travelled to each team and worked with members of the team in a number of structured sessions to develop their skills in searching and choosing LOs, downloading them to their own workspace, placing them into an organised sequence, customising pages to suit the local context and importing the products into a CMS for delivery. During the training sessions, the teams were given instructional support and learning and teaching ideas by other members of the project team.

In Team A, the teacher developed two online courses for students, Use Business Technologies (UBT) and Occupational Health and Safety (OHS). Both courses used The Learning Edge to locate useful resources from the repository and to download them. To complement the resources found on the repository, the teacher discovered a number Excel and PowerPoint files from other sources and included these as

resources in her learning setting. The use of the scenario and the various resources provided an authentic context for learning which was the teachers' intention and planned learning design. The Use Business Technologies unit was planned to incorporate a blended learning design that involved a mix of face-to-face instruction with individualised computer-based instruction. The learning design was based around a series of authentic tasks that formed the basis of the assessment and the learning activities. This course was developed using a number of development tools including The Learning Edge and Dreamweaver. The online component was built as a series of activities/resources that learners accessed through a WebCT interface. The Occupational Health and Safety Course online environment was developed with resources from available repositories. The units were delivered in a face-to-face mode across five 3 hour sessions at a Tasmanian TAFE Institute. They ran with 20 participants, all with varying and diverse prior experience with ICT in their workplace and home settings.

Team B developed a unit entitled WorkPlace Well Being (WWB) as an online version of an existing face to face course developed by the organisation. The emphasis was on self-directed learning and the measurement of learning outcomes. Key features included facilitated peer-to-peer communication using online tools, such as real-time (synchronous) chats and asynchronous (over time) discussion forums. In this eight week course there were five main topics. This blended online course covered a variety of topics to help develop and support mentally healthy workplaces. The learning design applied in the course for Topic 1 could best be described as informed conversation. The course aimed to promote students' understanding of issues associated with wellbeing in the workplace. In this topic students consider their current knowledge and understanding, read informed views and comments and then share their perceptions with others in an asynchronous communication. The learning occurs through the reflective reading and the online communication (at least two posts were required).

The site contained a variety of learning resources that students were able to access. The nature of the learning design employed meant that the resources could be used in ways that the students chose rather than being delivered in ways that restricted access to particular instructional forms. The resources themselves comprised mainly Word documents, and various Web documents in the form of pdf and HTML pages. The site included materials sourced from a variety of locations including Web sites, previous courses and resource collections owned by the developers. Within the resource set were a small number of resources obtained from the learning object repository provided by the Flexible Learning Toolboxes project, all delivered using Moodle (Figure 2).



Figure 2: The workplace wellbeing delivery format

The unit was delivered to a cohort of 12 students in an online mode across a 10 week period. Several staff facilitated and encouraged online participation through both synchronous and asynchronous modes with strong levels of tutor moderation. There were 6 students who formed the core of the online discussion with the remaining 6 students participating with less involvement in the discussions and communications components. The course represented typically about 12 hours of learning time for the students.

The third team constructed their planned online course in The Learning Edge, comprising four modules (Figure 3). Each of the four modules was designed to provide a self-contained online course for the students. The first module was designed to develop students' mathematical skills and capabilities and was derived from learning objects found in the repository. A front page describing the context and purpose was provided with a link to the actual learning activities. The learning design employed was driven very much by the forms of learner activity supported by the LOs taken from the repository. The environment included tasks which typically involved reading descriptions and elaborations and completing small consolidation and rehearsal activities. The majority of the learning outcomes related to acquisition of knowledge and the learning tasks tended to be low order tasks aimed at encouraging reading and some consideration of, and reflection on, the information.

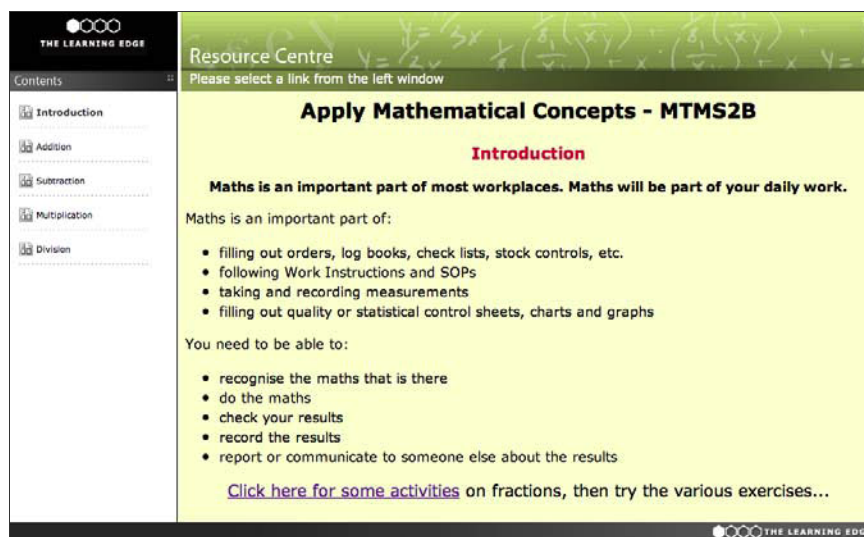


Figure 3: The introduction to the mathematics module within the learning edge setting

The design of the materials tended to involve creating a sequence with the chosen LOs and using the learning designs they contained as the basis for student activity. The resources were a mixture of Web pages from discrete LOs. Whilst the learning setting was intended for learners in the meat processing industry, it contained resources that had been designed for a variety of different learning settings. The mathematics activities were planned originally for building and construction and contained tasks relating to measurements etc. from this industry. The safety and health resources were drawn from learning settings designed primarily for health workers and related to hospital and medical sites.

In most instances the resources comprised Web pages with graphic and text. Some interactive elements were included but these were quite limited in their scope. Overall the resources were plentiful but limited in their media richness. Eight students participated in the trials and completed the course across a five week period. The students worked independently to complete the learning materials under the guidance of their tutor. They completed both modules as described above.

Outcomes and findings

The TLO project yielded many interesting outcomes in relation to how the teachers used the LOs in their lesson design and the types of learning environments that resulted. The project was limited in many respects in terms of the number of participants and the period over which it was conducted. The following findings are drawn from patterns and themes that emerged during the TLO. They are drawn from the

observed practices and from attempts to determine causal relationships between what was observed and the reasons that may have led to the outcomes.

a) The use of a stable and powerful content management system provides strong support for designing online learning units using learning objects

The participants in the Trial of Learning Objects used The Learning Edge content management system as the means by which they assembled and structured the learning objects into a SCORM-compliant form. This tool is a complex tool with many components and functional elements. With only small amounts of (well-delivered) instruction and support, even the least technical teachers in the trials were able to develop sound mental models of the system and its operation. Many of the teachers who will use learning objects may have low levels of technical skills and confidence. The infrastructure and supports for e-learning environments use many acronyms and many technically confusing options and the settings are likely to present many barriers to novices. The use of a conceptually sound tool like The Learning Edge, when coupled with sound professional development support, will enable all teachers to make use of repositories and learning objects in a relatively short period of time. And it is highly likely that teachers will quickly become self-sufficient users, as was observed in this study.

b) Repositories need to hold many learning objects to provide teachers with adequate choices to select the resources they require

The Trials of Learning Objects found that, in every instance, the participating teachers would have preferred to have access to more resources than were available to them. This finding was based on the fact that teachers had particular contexts and strategies in mind as they searched for resources and frequently found items that were potentially useful but not exactly what they were seeking. In order to more fully meet the needs of the teachers, it was felt that more variety and choice would have helped them to have more easily developed the environment they were seeking. This study was conducted at an early stage of the development and implementation of the relevant repositories, which accounts for the restricted number of learning objects available to the participants.

c) Many learning objects hold strong contextual connections with their original use, which can limit their reuse in other settings

The repositories used in the Trials of Learning Objects contained many resources which were relatively easy to discover and to use in the planned setting. One interesting observation was the strong context that many of the learning objects carried, that in some ways limited their opportunities for reuse. The mathematics learning objects, for example, were designed for use in the building industry. Fractions were taught as measures of building materials etc. In the Trial of Learning Objects, the mathematics was being taught to meat process workers. The sorts of calculations the students needed to make in this setting related mainly to weights of food as part of processing. This meant that while the algorithmic processes for working with fractions were dealt with, the context would have appeared a little strange to the learners. The development of learning objects needs to consider reuse, so that wherever possible decisions are taken that can support this aim.

d) The use of learning objects appears to have a strong fit with teachers' existing design and development strategies.

In the Trial of Learning Objects, the instructional design and development processes employed by the teachers appeared to be well supported by the use of learning objects. In most instances, teachers examined the competencies they were to deliver and went into the repositories to discover what resources might be available. In such instances, the available resources became the basis of the learning settings developed. With one team, the design of the learning environment was planned first and then resources were taken from the repositories that could support these outcomes. These different approaches resulted in quite different forms of learning setting but in both cases the use of learning objects was found to be a beneficial and positive addition to the processes of the teachers. It did not appear that to use learning objects teachers needed to adopt alternative or unfamiliar design processes.

e) The use of learning objects can discourage the use of task-oriented learning designs

Following on from the previous observation, it appeared through the Trials of Learning Objects that when teachers used learning objects in their design and development, they tended to be constrained by what resources they could discover and access. As such, the process tended to result in learning settings which revolved around objects as the principal learning elements. The preferable and more effective forms of

learning environments are those where learners undertake tasks and activities with resources as supports and scaffolds (rather than as learning agents). It appeared when the teachers did not have a deliberate learning strategy in mind, the availability of learning objects drew them towards the more directed and structured learning setting characteristic of information and content as an end in themselves rather than as items that learners learn to apply and use.

f) The majority of available learning objects tend to be of a tutorial form. There appear to be far fewer content and information learning objects from which teachers can choose

In this project, all teachers came to the repositories to seek learning objects that could support online learning in units with established objectives and learning outcomes. In searching the repositories, it was evident that the vast majority of learning objects were of a tutorial nature, in that they provided information and learning activities to consolidate knowledge and skill acquisition. The teachers were unable to source information and content alone for their units and this influenced the forms of learning design that they ultimately chose to use. It was felt that access to learning objects which could provide information alone about underpinning knowledge and concepts would have been very useful to designing effective learning settings.

g) The granularity of learning objects can influence their capacity for reuse. Larger objects tend to be less useful than smaller objects

In many instances in the Trials of Learning Objects, resources were discovered that strongly supported the planned learning outcomes. But in many of these instances, the grain size of the learning object meant that there was a high degree of other material in the learning objects that teachers did not necessarily want or need. Teachers remarked on a number of occasions that they would have liked to be able to have chosen parts of the learning objects rather than having to take the complete entity. This comment was also made by several students who recognised that, within the learning environment, they were being exposed to and required to use resources that were unnecessary and in some cases irrelevant. The problem exists in the grain size of the objects and their capacity to be further disaggregated. Often disaggregation is not possible without losing critical elements. The key to success is in the careful and deliberate design to ensure grain size is optimal to support reuse. Had more time been available to the participants in this study, they may have learned to use The Learning Edge to create content modules using learning objects, and, in this way, been able to achieve more customisation to meet their students' contexts.

h) Teachers do not appear to be inclined to seek to customise learning objects

There were few teachers in the trials who customised some of the learning objects they were using. This appeared to stem from a number of reasons. In the first instance few teachers appeared to have the technical capability to use the development tools to effect the changes that might be made. Secondly few teachers had the time needed to make any changes and, thirdly, the software assembling tools being used did not easily support customisation. If we know that teachers are not likely to want to, or be able to, make changes, it suggests that in the design of learning objects, developers need to consider ways to maximise the reuse potential in instances when changes and customisation are not likely to be possible.

i) Teachers would be advantaged by better descriptions of learning objects to aid their discovery and selection

Many of the teachers commented that the time taken to discover and access learning objects was increased significantly by the time it took to run a learning object and to review its contents. Teachers need to know precisely what is in the resources they choose for their students. They need to walk in the shoes of their students to ensure that the learning experience is what they want it to be. Previewing every learning object can be a time consuming process and one that limits the extent to which teachers will search and look. There exists a need for learning objects to be developed and stored in ways that might reduce the overheads of teachers seeking to use them. Possible solutions include stronger keyword and metadata descriptors, the use of detailed abstracts etc.

j) Repositories can conceal many of the learning objects that they contain

The project found that teachers took considerable time to discover and select learning objects for use in their learning settings. Whilst the various repositories had quite effective and efficient search functions, the nature of electronic storage meant that the teachers had little sense of the scope and extent of the learning objects in the repositories that may have been useful to them. It would have been helpful to the teachers to have been able to explore some summary data on repository contents to help them to know

which repositories held the most prospect for them to use and the scope and extent of learning objects appropriate to their needs.

k) The use of learning objects in designing online settings is a complex task for inexperienced users

The Trials of Learning Objects revealed that it is possible using available resources and infrastructure to develop online learning units for the VTE sector using learning objects from local repositories across a variety of discipline areas. It was also evident that the process can have many sticking points for teachers tackling the process for the first time. The problems include locating the repositories, discovering appropriate resources, being able to assemble them in a courseware management system for delivery and designing an effective learning setting with appropriate activities and assessments. It was evident that many teachers need access to appropriate training and support and would not be able to complete this process independently.

Implications for practice

The findings from this project, which sought to explore how teachers can use LOs, suggest the value of actions in the following areas if the use of LOs is to become a component of mainstream use of ICT in the Australian VTE sector. Actions are suggested in the key areas of design and development, assembling and storing and teacher use of, LOs.

The design and development of LOs

In designing and developing LOs, a number of strategies emerged as likely to maximise the opportunities for their reuse. For example, smaller objects appear to provide more opportunity for reuse than do larger ones, while objects that minimise discipline contexts can provide greater opportunities for reuse than those strongly tied to contexts. In terms of LO types, information and content LOs without any instructional elements can provide strong contexts for reuse, while LOs designed in ways that encourage and support simple and non-technical forms of customisation, will have enhanced reusability.

Assembling and storing LOs

In developing repositories and collections of LOs, the following strategies would appear to promote their usage. LOs need to be described accurately and fully with keywords that provide some sense of the scope of learning and the instructional/learning strategies involved. Repositories could aid teachers if they were able to provide some sense of the scope and extent of the resources they contain in relation to specific subject and discipline areas. The TLO found that strategies need to be adopted to source more LOs for inclusion in repositories. The strategies would need to extend to encourage organizations and individuals to share resources and to see advantage in this. There would be many benefits gained if repository projects included a contributory process that allowed teachers and designers to contribute quality assured LOs to the repositories as well as being able to use existing objects. The inclusion of a metadata maintenance program and an automated metadata implementation and validation process would ensure metadata quality and integrity for all stored LOs.

Systems to support teacher use of LOs

In considering the forms of supports needed by teachers to create online settings using LOs, the following strategies emerged as necessary to support further uptake and use. Comprehensive support strategies are needed to enable first time users to employ LOs in elearning and the uptake and use of LOs will likely be very slow if this support is not deliberately designed and provided. The training support for users of LOs needs to include strategies in both linking and/or re-packaging/customising resources. This would allow teachers and designers to take smaller parts of LOs as required. Given the increasing opportunity for using LOs, teachers would be supported greatly with access to learning design templates that support quality learning designs using LOs and successful uses of LOs by teachers in all their forms, e.g. blended learning, fully on-line etc. need to be publicised to promote this as a mainstream strategy for course and unit delivery. It would appear that targeted professional development focusing on design and customisation strategies for novices and intermediate users would be a particularly useful support strategy.

Whilst the Trials of Learning Objects was undertaken in the Australian VTE sector, the findings have relevance and application in settings beyond this context. Both the school and higher education sector in Australia make significant use of ICT and as yet are probably less advanced in their moves to apply LOs as learning and teaching resources. The findings from this study into teachers' needs and factors influencing uptake and usage should inform and guide much of the current practice across all sectors. Clearly there is need for significantly more research and inquiry across all sectors if the opportunities and advantages promised by the new technologies, in relation to reusability and sharing, are to be fully realised. The TLO has highlighted a number of areas where creative solutions are needed to overcome the difficulties and obstacles required to mainstream LOs as effective, discoverable and usable learning and teaching resources.

References

- Agostinho, S., Bennett, S., Lockyer, L., & Harper, B. (2004). Developing a learning object metadata application profile based on LOM suitable for the Australian higher education context. *Australasian Journal of Educational Technology*, 20(2), 191–208.
- Beetham, H. (2004). *Review: Developing e-Learning Models for the JISC Practitioner Communities*. Retrieved January 23 2006, from http://www.jisc.ac.uk/uploaded_documents/Review_emodels_draft.doc.doc
- Britain, S. (2004). *A Review of Learning Design: Concept, Specification and Tools*. Retrieved 21 January 2006, from http://www.jisc.ac.uk/index.cfm?name=project_earn_ped_learning_design_tools
- Brownfield, G. & Oliver, R. (2003). Factors influencing the discovery and reusability of digital resources for teaching and learning. In G.Crisp, D. Thiele, I. Scholten, S. Barker & J. Baron (Eds.) *Interact, Integrate, Impact: Proceedings of the 20th Annual Conference of ascilite* (pp 74–83). Adelaide, ascilite
- Downes, S. (2000). *Learning Objects*. Retrieved June 2002 from: http://www.atl.ualberta.ca/downes/namwb/column000523_1.htm
- Hand, T. (2004). Learning Objects: User Perspectives on the Conditions Surrounding Their Use. In P. Kommers & G. Richards (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2004* (pp. 66–72). Chesapeake, VA: AACE.
- Jonassen, D. & Churchill, D. (2004). *Is There a Learning Orientation in Learning Objects?*. International Journal on E-Learning. 3 (2), pp. 32–41. Norfolk, VA: AACE.
- LTSC (2001). *IEEE Learning Technology Standards Committee Website*. Retrieved May 2, 2003, from http://ltsc.ieee.org/wg12/s_p.html
- Littlejohn, A. (2004). *The Effectiveness Of Resources, Tools And Support Services Used By Practitioners In Designing And Delivering E-Learning Activities*. Retrieved 27 January 2006 from www.jisc.ac.uk/uploaded_documents/
- LOM (2002). *IEEE Standard for Learning Object Metadata*, IEEE, 1484, 12.1-2002, IEEE.
- Oliver, R., Wirski, R., Wait, L. & Blanksby, V. (2005). Learning designs and learning objects: where pedagogy meets technology. In C. Looi, D. Jonassen & M. Ikeda, (Eds). *Towards Sustainable And Scalable Educational Innovations Informed By The Learning Sciences* (pp. 330–337). Amsterdam: IOS Press.
- Rehak, D., & Mason, R. (2003). Keeping the learning in learning objects. In A. Littlejohn (Ed.), *Reusing Online Resources: A Sustainable Approach To Elearning* (pp. 20–34). London: Kogan Page.
- Shepherd, C. (2000). *Objects of Interest*. Retrieved June 2002 from: <http://www.fastrak-consulting.co.uk/tactix/features/objects.htm>
- W3C XQuery (2003). *World Wide Web Consortium Xquery1.0: An XML Query language. W3C Working Draft May 2 2003*. Retrieved May 22, 2003, from <http://www.w3.org/TR/exquery>
- W3C SOAP (2000). *World Wide Web Consortium Simple Object Access Protocol 1.1. W3C Note, May 8 2000*. Retrieved May 22, 2003, from <http://www.w3.org/TR/SOAP>
- Wiley, D. (2003). *Learning Objects: Difficulties and Opportunities*. Retrieved 22 November 2004, from http://wiley.ed.usu.edu/docs/lo_do.pdf
- ZOOM (2003). *The Z39.50 Object Oriented Model*, Retrieved May 22, 2003, from <http://zoom.z3950.org>

Author contact details

Ron Oliver, Associate Dean (Teaching and Learning) Edith Cowan University, 2 Bradford St, Mt Lawley, WA 6050, Australia. Email: r.oliver@ecu.edu.au

Copyright © 2006 Oliver, R., McMahon, M., Higgs, P., Shum, R. Wait, L., Lou, D.

The author(s) assign to ascilite and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The author(s) also grant a non-exclusive licence to ascilite to publish this document on the ascilite web site (including any mirror or archival sites that may be developed) and in electronic and printed form within the ascilite *Conference Proceedings*. Any other usage is prohibited without the express permission of the author(s). For the appropriate way of citing this article, please see the frontmatter of the *Conference Proceedings*.