An Assessment of the Learning Objects, Models and Frameworks Developed by The Le@rning Federation Schools Online Curriculum Content Initiative Australia

Phase Two

_____

January, 2005

Prepared for

The Le@rning Federation

Consultants

B. Muirhead, PhD
Muirhead Consultants
Oshawa, ON

and

M. Haughey, PhD
Whitepark Consultants
Edmonton, AB

Executive Summary

This report is in response to a Request for Proposals from The Le@rning Federation Secretariat, Adelaide, Australia. The work was completed between November 2004 and January 2005. The project was limited to the current content development initiative of The Le@rning Federation.

Goals
This consultancy focuses on the content development emphasis of the Initiative, the place of The Le@rning Federation internationally, how The Le@rning Federation has taken into account the recommendations from the Phase One Review and whether it should continue to focus on 100% quality in its instructional design of learning objects. The four specific questions posed to the researchers were

> *1. Since the last review what has changed in international development, design and pedagogical contexts in relation to instructional design for children, the development of K-12 learning objects, and their pedagogical use to support learning outcomes?*
>
> *2. Has The Le@rning Federation taken account of feedback provided in the Phase One Review?*
>
> *3. Has The Le@rning Federation retained a position of leadership in relation to development of K-12 materials?*
>
> *4. In the light of international practice, what are the arguments for and against retaining The Le@rning Federation's focus on 100% quality in instructional design?*

Methodology

1. An updated literature review was conducted regarding recent developments about learning objects. This review focused on the international context for learning object design and how the Le@rning Federation's work has kept pace with international developments.
2. Interviews were conducted with members of The Le@rning Federation team and secretariat.
3. A number of relevant documents produced by The Le@rning Federation since September 2003 were read.
4. A review of 20 items of recent The Le@rning Federation online content was undertaken.

From these activities an analysis of all resulting data was conducted in order to address the research questions.

In the course of the analysis the consultants have made some suggestions for future directions and criteria to be considered in the development of the next generation of learning objects.

Findings

1. Since the last review what has changed in international development, design and pedagogical contexts in relation to instructional design for children, the development of K-12 learning objects, and their pedagogical use to support learning outcomes?

The purpose and definition of learning objects still generates interest in the literature although the overall number of publications on learning objects fell substantially in 2004. In one sense this reflects a general movement away from discussions about specifications to more focused discussions about what actually happens in practice and hence to a more education-focused discussion of learning objects.

Discussions about the place of pedagogy suggest that while some is always present in the design, the placement of the object in the context of the learning activities in the classroom is most fruitfully the teacher's decision. Hence, teachers' levels of comfort with and use of learning objects will provide the next most important benchmarks in the utilization of learning objects.

Much of the literature, then, has moved its focus from definition to reusability. There is support for the notion that pedagogy is best left to the context rather than to the content of the object, a position that is in accordance with that taken by the Federation's networks.

Reusability requires a database or repository and writers were concerned about issues such as the fatigue of metatagging, and reuse of publishers' materials. One area where reuse was high was in purpose-built materials for common use, suggesting again the benefits of the work done by The Le@rning Federation's various curriculum committees to identify appropriate learning objectives and topics.

Some literature focused on the rise of virtual learning environments which may be valuable if schools are considering embedding objects in distance learning materials. However, the importance of these being educational rather than informational environments was stressed. For the object to be used for learning, it has to be integrated into a specifically designed learning environment that ties it to learning activities. This is the challenge for classroom educators and one where there is an important bridging role between designers and teachers who pilot learning objects.

In the K-12 sector, there has been little comparative sustained quality development of learning objects. Attempts to encourage teachers to develop their own resulted in a large number of objects but most of these were used only by the teacher developer and followed simple template patterns for recurrent tasks. The most successful learning objects came from teams whose members had expertise in instructional design, technology use in classrooms, and the subject matter. Sustainability required willing teacher users who could easily access, use and choose from sufficient numbers of learning objects that met the learning interests of their pupils.

The development of learning objects has been supported by literature and field-based research studies on a wide range of topics associated with learning objects from strategies to overcome teachers' barriers to and enable success in using ICTs, or the motivational effect of ICTs on pupils, to ICT links to pupil attainment, and to studies of actual use. From this work, teachers' development of confidence with technology, easy access to a relatively robust infrastructure, and the ready availability of learning objects were stressed as important strategies in overcoming barriers. Teacher resistance to change, whether linked to pedagogical style or unwillingness to learn, was also identified as a barrier that prevents full integration of ICTs in classrooms. There is an emerging literature relating assessment to online curriculum and curriculum content.

In terms of pedagogical concerns, findings from two studies showed that while teacher education students might be guided about what to design by the classroom teacher, ensuring the quality and richness of the learning object was beyond their capabilities. Like teachers in other studies, students were able to design learning objects, but these did not have the capacity for multiple use, to include varied rich resources, and were not as inventive and engaging as today's students require.

In particular, a number of studies highlighted the importance of visible and fade-able scaffolding to meet students' individual needs and learning styles; the use of narrative both as a story telling device, and also as a way to communicate interactively with students; and a combination of realistic and symbolic visualizations to enhance credibility, student interest, ownership, and capacity to learn.

The studies on teacher use of learning objects are usually caught in what is referred to as the "halo" effect, changes in behavior induced by their knowledge of being a study participant. More fruitful are studies that are action-research based and document teacher use over time, that involve the teachers themselves as researchers, and that sustain interest through community networks of practice.

Studies on student use are essential to ensure that the design features engage today's learners, and are sophisticated enough to allow for repeated use.

There is an extensive literature on continued professional development for teachers around technology integration. The use of learning objects provides a practical focus for such work. Equally it requires experienced teachers to design different kinds of pedagogical approaches, to develop new competencies in integrating pedagogy and technology and to share practices in order to build on each other's expertise. This is not knowledge that is already available; just as learning for students is considered most valuable when it is contextualized to their interests and situation, so it is with teachers. The most appropriate professional development model is not a cascade model using a train the trainers approach but a community of practice model that is localized and builds new expertise on extensive classroom pedagogical experience.

2. Has The Le@rning Federation taken account of feedback provided in the Phase One Review?

With one exception feedback from the last review has been acted upon. From the review of recently developed content we conclude:

- without exception, learning objects displayed accurate information and reflected current thinking regarding "integrity" or the ways in which knowledge is conceptualized within specific domains

- as greater numbers of learning objects are developed the importance of teacher support grows, requiring some guidance for teachers to link learning objects to curricular statements and other resources available to them and their students

- in designing the learning objects, developers were highly cognizant of the need to sensitively address community and cultural membership, including written and spoken language

- learning objects show greater diversity in learning materials, better navigation and improved design options, and greater learner choice

- the six learning assets illustrate the potential possibilities for use of archived data by teachers and learners in a wide variety of instructional settings

- overall, developers were highly successful in their abilities to address the issues that have been identified in the literature on learning objects (e.g., size, aggregation, flexibility, localization, and customization).

The one exception where feedback has not been incorporated is the recommendation of the Phase One reviewers that an online teachers exchange

be developed to encourage the sharing of best practices, classroom instructional material, units, or modules which employed learning objects. This has not been implemented as it is outside the scope of The Le@rning Federation's current terms of reference.

While the reviewers acknowledge that this undertaking falls outside of the current scope for The Le@rning Federation, it is still our view that as more educators gain access to learning objects and begin to use these high quality assets in classrooms, the importance of the online site will increase. It is conceivable that as The Le@rning Federation moves into a second phase that a teacher exchange mechanism which can build a national community of practice will be critical to successfully implementing learning objects in classrooms across Australia and New Zealand.

In summary, the researchers found that recommendations made in the Phase One Review have either been accepted, are being implemented or are under active consideration. The adoption of so many recommendations demonstrates the openness of The Le@rning Federation to new ideas and to its confidence in seeking the opinions of critical friends.

3. Has The Le@rning Federation retained a position of leadership in relation to development of K-12 materials?

- Development, progress and thinking within The Le@rning Federation are consistent with international thinking and development over the last 18 months. Issues of pedagogy, scaffolding, design, reusability and accessibility are being addressed by The Le@rning Federation as they are by CELEBRATE, the US Department of Education, BECTA and the research literature.

- The products of The Le@rning Federation are of global standard both technically and pedagogically.

- There is clear evidence of flexibility and adaptability in developments since the last review. This is evidenced by improved design (e.g., graphics, additional challenge level), improved navigation and textual assistance.

- Over the past 18 months, the type, size, and instructional design of Le@rning Federation learning objects have expanded. Rather than following a single design philosophy throughout all objects, the increasing diversity of design elements reflects a growing awareness of new possibilities in learning object design. Within disparate curricular areas there exist a variety of architectures concerning functionality and the treatment of content.

- In interviews with The Le@rning Federation personnel two approaches emerged regarding accessibility. One was to incorporate accessibility features into all learning objects thus in some cases making the learning objects more complex to develop, more costly to create and in limited cases adversely affecting the overall design of the learning object. A second approach being considered was to develop separate purpose-built learning objects for specific learners with special needs. While commonsense dictates that a balanced approach resulting in some accessibility features being included in all learning objects is desirable, designing learning objects for students with specific and diverse learning disabilities remains a challenge for The Le@rning Federation and for educators across the globe as they commit to the widest accessibility possible for all learners.

In summary, our investigation demonstrated the developing national infrastructure and emerging sector strength among both public and private sector organizations geared towards developing learning objects that enhance educational attainment in Australia and New Zealand. The findings underscore the significant progress The Le@rning Federation continues to make in achieving the goal of enhancing learning through providing educators with digital learning materials. The international leadership position of The Le@rning Federation remains intact. No similar project has emerged and The Le@rning Federation continues to pioneer content development and the expansion of interoperability throughout Australia and between New Zealand and Australia.

4. In the light of international practice, what are the arguments for and against retaining The Le@rning Federation's focus on 100% quality in instructional design?

Against retaining the focus is the argument that content can be garnered from the Internet and other sources without priority for instructional design and simply repurposed by teachers or in the home. Giving weight to the cheapness of existing generic, free resources, the capacity of teachers and students to use these for educational advantage and the value of redirecting educational content budgets, this argument accords no role for a specifically *educational* transformation to be achieved through instructional design. While there is capacity for a wide range of information and entertainment based resources to enrich education, it is through the evolution of instructional design applications and break-throughs that real educational progress is likely to be made.

In part, due to the unique position that The Le@rning Federation occupies nationally and internationally, there are no similar programs to serve as a comparison. Therefore, the standards developed (based on emerging international standards, predominantly from the training or postsecondary sector) must be considered the "current state of the art" for the schooling sector. While LearnAlberta.ca is a project to develop and deliver multimedia content and

learning objects to school-aged students, its most recent emphasis on repurposing existing multimedia content, digitizing media from traditional media companies (for example, National Geographic) and distributing content through a closed repository structure or through the use of secure distributed servers on local area networks makes comparisons unworkable and consequently does not provide a benchmark.

Researchers feel that the development of standards documents to inform practice is the correct approach. Moreover, the multiple versioning of the documents signals an understanding that learning object development and learning object standards are rapidly evolving areas and that standards are living documents reflecting "current thinking". Therefore standards cannot be static or inflexible.

To successfully apply quality assurance processes involves not only the development of standards but also the capacity to employ them. In this area The Le@rning Federation has been highly successful in building capacity across the system. However, in doing so, they have assumed a "consultative overhead" to Le@rning Federation operations.

As noted earlier, The Le@rning Federation is breaking new ground with few if any precedents. The nature of its activities, which can be defined as "original and innovative," require The Le@rning Federation to work collaboratively with an extensive group of partners. As well this ensures that learning objects can be used in local settings but also to capture knowledge from across Australia and New Zealand. Education ministries from nine jurisdictions, the Australian government, the Government of New Zealand, the private sector, cultural institutions, museums, local schools, curricular experts, project officers, and teachers are but a short list of those with whom The Le@rning Federation has worked in recent years. In doing so, The Le@rning Federation has built the capacity of these stakeholders to address in some way instructional design.

It is clear that the efforts necessary to build a coherent and collective understanding among such diverse groups is a capacity building activity. While it results in additional costs to The Le@rning Federation and local jurisdictions, and greatly increases the time required to move from "design to publish", the result is a growing awareness of the importance of instructional design to the final "product" and therefore how best to use quality designed learning objects with students and teachers. Without an effort to build the capacity to understand the concept of learning objects, it is entirely possible that the content developed would be of the highest quality but little understood and therefore little used in classrooms. Additionally, without an emphasis on instructional design as capacity building, the competitive benefits accruing to the private sector in competing for national or international projects could not occur. In large multi-sectored or multi-jurisdictional projects, the value-added of shared understanding, new insights or greater capacities developed through involvement are overlooked in final

evaluations. In this case, a focus on instructional design as capacity building has produced an education sector ready to use learning objects and a private sector able to deliver high quality learning objects.

Unlike the software development industry which emerged following WWII, or private sector organizations which first employed computer technology for quantification purposes (data management) in the 1960s, in many respects the education sector is still taking preliminary steps in using information and communication technologies to enhance learning. While the private sector began incorporating desktop computer technologies into core business practices in the 1980s the education sector is still in the process of integrating technologies into its core operations.

The building of local computer infrastructures has had a critical effect on the ability of The Le@rning Federation to distribute and use digital learning materials (interoperability). As a result, it is crucial that the focus upon instructional design as primary research be strengthened by a continued focus on gathering data about the infrastructures necessary to ensure that maximum benefits are obtained from use of learning objects in the classroom. Projects such as The Le@rning Federation are providing important connections between past and future practices in infrastructure, digital content and teaching practices.

For these reasons the researchers believe that although it may be easier and cheaper to harvest content without high levels of instructional design compliance, the balance of the argument is currently, and will remain for some time in favour of high levels of compliance with instructional design criteria. It is only through the hard work of establishing clear standards and benchmarks for instructional design that the education sector can progress and reap the transformative benefits of ICT.

The focus on instructional design as central to continuing efforts at developing the highest quality learning objects remains essential to the success of the overall project. Maintaining this focus ensures continuing support from The Le@rning Federation's multi-sector and jurisdictional partners and from the wider learning community where initial skepticism is being replaced with growing respect.

Further Steps

While the consultancy brief was focused on the four questions above, in the course of their research the consultants formed opinions on some ways in which The Le@rning Federation could build on the success of the content development initiative.

1. The Le@rning Federation contribution to more widespread use of online curriculum content would be significantly improved by an expansion of its mandate to enable it to develop communities of practice among learners

and instructors involved with the content development initiative. Communities of practice hold significant value to both educators but also to the developer community and new insights into learning objects are developed and a variety of perspectives shared. A user community in is important for "growing the product" as well as for growing user skill.

2. A research mandate in its terms of reference would assist The Le@rning Federation to ensure that learning objects are meeting, over time, the goals set out for enhancing learning outcomes. Different kinds of research are essential so as to identify the level of teacher use and comfort with learning objects, the enablers and barriers re teachers' use of ICT and learning objects, the effects of use of ICT and learning objects on teachers' practice and student learning outcomes, the relationship of use of learning objects to teachers' pedagogy, extended student feedback on the design and motivational aspects of learning objects, an assessment of the various organizations' capacity to support effective and efficient access and use of learning objects, and the most effective ways to enhance use of learning objects in the classroom.

3. The Le@rning Federation could investigate the development of a teacher exchange to share classroom materials developed by teachers using Le@rning Federation learning objects. The development of peer review mechanisms and criteria will ensure the teacher materials are of professional quality.

4. In the Phase One Review we recommend the inclusion of linkages to external resources within learning objects. With the current range of delivery processes used by jurisdictions this is not possible until delivery is more consistent and technologically open. The Le@rning Federation should continue to pursue the benefits of linking learning objects with other available quality online resources. These links will be critical as additional learning assets are placed in The Le@rning Federation Exchange where contextual references will be most needed.

5. The inclusion of learning assets in The Le@rning Federation exchange suggests there is value in adding additional learning materials from the current initiative into the exchange. We encourage The Le@rning Federation to partner with similar projects internationally to exchange materials thereby adding to the number of quality learning objects available to teachers.

6. We also encourage The Le@rning Federation to explore new ways of involving the teaching community in using the learning object "templates" to create derivative objects for sharing through the proposed teacher exchange.

7. We encourage The Le@rning Federation to explore developing virtual learning environment (VLE) for use by educators. Such a VLE would provide not only an environment for interaction but also be a powerful medium for teachers to create and "publish" learning materials for new learning activities.

8. We encourage The Le@rning Federation to begin building a student project site which would recognize exemplary student work based on the use of learning objects. This site would also provide example to teachers of how to use learning objects in classrooms and in designing learning activities.

10. Finally we would encourage The Le@rning Federation to establish some form of recognition to ensure teachers who use learning objects in their teaching practice and/or develop learning objects which meet The Le@rning Federation standards are acknowledged. These awards would support innovative practices at the classroom level. In addition, we would recommend that similar efforts be focused on student achievement.

Detailed comments and further suggestions are included in the text of the report.

Table of Contents

1. Introduction

This document is in response to a Request for Proposals from the Le@rning Federation, Melbourne, Australia and was completed between November 10 2004-January 30, 2005. The review of literature builds upon an earlier paper prepared in September 2003 (**An Assessment of the Learning Objects, Models and Frameworks Developed by the Le@rning Federation Schools Online Curriculum Content Initiative Australia).**

1.1 The Le@rning Federation

The Le@rning Federation is an initiative of the State, Territory and Commonwealth governments of Australia and the government of New Zealand. The purpose of The Le@rning Federation initiative is to "create online curriculum content and the infrastructure (The Exchange) for procurement, storage and distributed access of the content specifically for Australian and New Zealand schools. It is expected that the content will be directly relevant to the curricula of the two countries, involve an "object oriented" approach to development which will allow for reassembling and repurposing to meet the needs of teachers and students, meet a set of development specifications and technical concerns such as interoperability and accessibility, include users and obtain user feedback throughout the development process and partner curriculum experts with the online developers. The Initiative is coordinated by the Australian Education Systems Officials Committee (AESOC) and is a Joint Venture of the Curriculum Corporation and *education.au limited*. It involves a wide range of groups, organizations and individuals interested in curriculum, content development and ICT.

1.2 Goals of the Review

This review focuses on the content development emphasis of the Initiative, the place of the Learning Federation internationally, how The Le@rning Federation had taken into account the recommendations from the Phase One Review and whether it should continue to focus on 100% quality in its instructional design of learning objects. The four specific questions posed to the researchers were

> *1. Since the last review what has changed in international development, design and pedagogical contexts in relation to instructional design for children, the development of K-12 learning objects, and their pedagogical use to support learning outcomes?*
>
> *2. Has The Le@rning Federation taken account of feedback provided in the Phase One Review?*
>
> *3. Has The Le@rning Federation retained a position of leadership in relation to development of K-12 materials?*

4. In the light of international practice, what are the arguments for and against retaining The Le@rning Federation's focus on 100% quality in instructional design?

1.3 Overview

To begin our work, it was important to gain a more intimate understanding of the work of The Le@rning Federation. A site visit was undertaken during November 15-23, 2004 to gather data from senior Le@rning Federation staff in Melbourne, review internal and public documents pertaining to the operations of The Le@rning Federation, review 14 learning objects including the metadata for each learning object, meet with the Secretariat, and examine presentation tools developed for learning object use in classrooms. The meetings with Le@rning Federation personnel resulted in 11, 90 minute interviews which were used to supplement paper based and digital resource materials.

1.4 The purpose and definition of learning objects

This topic continues to be important. A clear definition helps those new to the field develop a conceptual framework which they can use to place learning objects in the context of their own pedagogical and experiential knowledge. However, a generally accepted definition remains a topic of debate and although much less is now written about it, the issues remain the same. As Clyde (2004) notes,

> *the concept of learning objects is based in both instructional technology and computer science. Instructional technology has been a factor in the current shift of instruction towards more student-centered, problem-based strategies. Computer science has contributed the ideas associated with object-oriented programming and computing.* (p. 55)

In reality, much of the work on the definition of learning objects has focused on their computing rather than pedagogical aspects and this is often confusing to newcomers looking for a way to link the concept to their prior educational knowledge. For example, McGreal (2004) defines the purpose of learning objects (LOs) as to "enable and facilitate the use of educational content online" (¶ 1). He goes on to note that they "are sometimes defined as being educational resources that can be employed in technology-supported learning" (¶ 3) and concludes that "there is no commonly accepted definitive definition of LOs. It is proving remarkably difficult to come up with a common definition" (¶11). In comparison, Wiley (2000) sees the core purpose for learning objects as enabling instructional designers to build small instructional components that can be reused in different circumstances and defines them as "any digital resource that can be used to support learning." Parrish (2004) suggests that while Wiley's definition places a boundary around what a learning object includes, it does not eliminate software

tools such as word processors, or e-mail (p. 52). Instead, Parrish proposes that it might be more fruitful to think of learning objects as a process or strategy.

Smith (2004) who developed *Guidelines for authors of learning objects* for the New Media Consortium in the US, concludes that "one thing that most descriptions have in common is that they focus on how learning objects are created, used and stored, rather than on what learning objects look like" (p. 1). She supports a working definition based on the work of Johnson (2003) who saw the most common definition of a learning object as "a collection of digital materials—pictures, documents, simulations—coupled with a clear and measurable learning objective or designed to support a learning process" (p. 4).

This definition reiterates a position of pedagogical neutrality which is itself contentious. McCormick (2003), reflecting on his experiences with the British CELEBRATE project, argues that efforts to include a definite pedagogy are doomed to failure and perpetuate the production of low-level encapsulations of unsophisticated views of learning. Based on his experience with CELEBRATE, he advocates that the pedagogy should not be in the object itself but constructed by the teacher. He proposes "an approach that advocates the development of LOs with sophisticated, high quality media representations of content, around which teachers build learning activities and assessment" (¶ 2).

Polsani (2003) includes the idea of reusability as essential to the definition of an object. He rejects the definitions provided by the IEEE and by Wiley as too encompassing and unwieldy and argues for a definition of "an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts" (¶ 14). He stresses learning use and reusability as the critical characteristics.

Looked at from the perspective of educators, the questions around definition usually entail the difference between these learning resources and any other materials teachers might use. As Johnson's definition makes clear, the materials are digitized and hence accessed over a computer network, and they are organized in some format chosen because it best meets the designated learning objective for this learning object. In some objects this format is highly structured into a sequenced pathway while in others, learners can choose the order of the activities or develop their own.

When teachers choose teaching resources they may identify items such as artifacts or pictures to which they add their own objectives or they may choose items such as a commercially prepared kit or book whose learning objectives are generally in alignment with their intentions. Teachers are anxious to obtain high quality learning materials that combine items, use strategies, or present ideas in ways that they would be unable to provide from their own resources. Traditionally, teachers decide what their students need and what approach to use; recent changes in our knowledge about learning has promoted more

collaborative and cooperative learning that is student-centered and activity and problem-oriented (Bransford, Brown & Cocking, 1999). To teachers, this has meant increasing diversification of learning materials while paying greater attention to individual and small group needs. The choice of strategy and resources, once chosen for the class, now needs to be reconsidered for individual learners and, as students gain in responsibility, eventually given to the learners themselves. In such a context, teachers are likely to desire a range of learning objects, some that deal definitively with certain factual topics while others that provide flexibility. Teachers' comfort with and use of learning objects are likely to be the next most important benchmarks for the design and purpose of learning objects.

2. The International Context

Over the last two years, the emphasis in the literature has shifted from the definition and purpose of learning objects to the reusability of learning objects and the development of learning object repositories. Another shift in perspective has been the turn towards virtual learning systems and their impact on the development of learning objects.

2.1 Reusability

While teachers may be most concerned with the flexibility of the design of the instructional strategies and information that make up a learning object, developers are more likely to be concerned with the object's reusability. In the previous review (Muirhead & Haughey, 2003) we noted the international developments around standards and the concomitant rise in the numbers of repositories that were developed to discover, catalogue and disseminate learning objects. That work has continued. The key rationale for the development of these electronic catalogues is reusability, and learning objects, seen as "digital files used to generate e-learning activities," are their "building blocks" (Richards, McGreal, Hatala, & Friesen, 2002, p. 68). Return on investment, given the cost of development of learning objects, provides one argument for reuse but so also do access to high quality content, reuse of outstanding teaching strategies and development of learners' generic learning skills (Collis & Strijker, 2003).

According to Collis and Strijker (2003), "the reuse of digital learning material has been an issue for over two decades" (p. 5). Initially, the problem was attributed to the relatively primitive level of the technology and to issues of access and lack of awareness among instructors. Yet, despite subsequent technological improvements and increasing awareness of learning objects, there has been relatively little evidence of reuse. Collis and Strijker attribute this to "the local culture and context of the end users" (p. 5), i.e., the instructors and suggest that a pedagogical approach to reuse needs to be considered.

They propose that the fundamental issue in the reuse of learning objects concerns conceptualizations of the learning process; "Where is the heart of the learning process? In the delivery of pre-made learning objects or in the support of learning activities involving human interaction and problem solving in authentic contexts making reuse of relevant experience?" (p. 7). In this, they support McCormick's (2004) position that the pedagogy is best decided in context rather than embedded in the object.

Collis and Strijker (2003) sought to assist instructors re-use the materials generated in an online course. They found that this was already common in that experienced instructors using a course management system would retain much of the materials they had previously generated and possibly include, with their permission, postings and assignments from prior students in the next offering of the course. What they were less successful in promoting was the release of these learning objects for use by others, meta-tagging of the materials, and the instructors' use of materials developed by colleagues.

Such studies are very important in helping us understand the actual use and reuse of learning objects. Boyle (2003) sought to develop a series of learning objects for a course he was teaching. He found that following the IEEE definition for minimum size based on a single learning goal led to single goal objects that were pedagogically unexciting. His conclusion was to link simple objects together to form compounds that not only greatly increased the pedagogical richness for the learner but also provided an easier means for subsequent re-purposing since the single items could be easily de-coupled.

Repositories continue to evolve as researchers attempt to develop systems which will overcome acknowledged shortcomings. Richards et al. (2002) identified three. The most frequently mentioned is the "complexity of meta-tagging" (p. 75) which is caught between the developer's fatigue at comprehensive labeling and the would-be user's inability to access the learning object through lack of sufficient identifiers. One proposed resolution has been attempts to automate the task with visual interfaces (Bray, 2001. cited in Richards et al, 2002); another has been to develop different levels of retrieval specificity from global to more detailed (Richards, et al, 2002).

A second concern has been security since developers need to be comfortable with the level of access to the repository. At the same time, persistence "which implies that the object will actually be retrievable on demand" (p. 76) raises questions about the system capacity of the network when there is simultaneous heavy demand for that object. One example of an attempt to overcome these concerns has been the development of the Creative Commons project at University of British Columbia (Lamb, 2004). Lamb identifies three common concerns of developers: the requirement of personal attribution from re-users, the unacknowledged commercialization of their materials, and inappropriate modifications to the object which would conflict with their own copyright

arrangements for use of materials and mar their reputation as scholars. The Creative Commons has attempted to address these through development of specific licensing arrangements that also allow free access to the objects.

The third concern identified by Richards and his colleagues was the lack of any quality assurance process in most databases. While there have been a number of suggestions, the most frequently mentioned is the peer community review process used by MERLOT. This process is seen as a means for "professional development for educators and a way of establishing and sharing design heuristics and benchmarks that will enhance the overall quality of the learning objects" (p. 77).

Other concerns have also been identified. Poupa and Forte (2003) respectively serve on and chair the ARIADNE Foundation for the European Knowledge Pool, a non-commercial organization charged with the maintenance and further development of the learning tools and activities funded under the ARIADNE projects (1996-2000) (http://www.ariadne-eu.org/). In their discussion of reuse issues faced by their community, they too list author reluctance and quality assessment but also add lack of recognition for advancement of academic developers, and publishers' restrictions on authors' reuse of materials. In a review of the efforts of digital repositories, McLaren (2004) commented on the SeSDL project (Scottish Electronic Staff Development Library) (www.sesdl.scotcit.ac.uk/). Again, this project was targeted to higher education institutions and similar issues with content sharing were identified. In addition to those already listed, he identified barriers attributed to variable levels of technical knowledge, and lack of appropriate software for downloading and customizing materials; however, some materials were heavily used across the community, "in particular the purpose-built interactive lessons on various learning technologies" (p. 68). This suggests the advantages that may be gained through collaborative planning for common use.

McLaren (2004) also identified the non-commercial nature of the ARIADE Foundation in comparison to the commercial orientation of some other repositories such as EOE (Educational Object Economy) and noted that X4L (Exchange for Learning) (http://www.x4l.org/), a project within the JISC (Joint Information Systems Committee) in the UK, "is hoping to demonstrate the economic as well as educational return on investment from the objects approach" (p. 68). Other companies embarking on capturing the economic benefits include Intralibrary, which is a library-based, digital content management repository developed by the Scottish libraries (Duncan, 2003) (www.intrallect.com). Long (2004) makes a similar argument about the value of libraries and the need for closer links between libraries and course management systems. Most recently, the Interaction of IT Systems and Repositories project (IISR)) which continues the original Collaborative Online and Information Services (COLIS), now housed at Macquarie University, Australia, announced that it is to "swap out its existing learning object repository with Intrallect's IntraLibrary" (Kraan, ¶ 1), a project

designed to test the substitutability of software systems and the capabilities of a managed learning environments (MLEs).

2.2   Virtual learning environments

Besides databases and repositories, virtual learning environments are another aspect of software development that is having an increasing impact on education. Long (2004) comments, "Course management systems have gone mainstream. If your college doesn't have one, it will." Course management systems are "a dominant component of today's educational technology landscape" (¶ 1). According to McLaren (2004), "the issue of pedagogical direction seems once more to have been sidelined in the decision-making process, in so far as many commercial products reinforce the delivery model of education" (p. 68). He, instead, supports Laurillard's (2002) conversational model of learning which stresses the ongoing negotiation through discussion between the teacher and student based on their individual conceptions of what is occurring. For Laurillard, the advantage of a virtual environment is the possibility for multiple conversations among learners which foster active involvement and builds a sense of community. Her group at the British Open University designed specific tools to encourage this process.

While McLaren is concerned about the adoption of transmissive pedagogical models, others view these new environments as potentially transformative in that the learner can access objects directly without the involvement of a teacher. For example, Nichani (2001) suggested that LCMS = LMS +CMS [RLOs]. By this he meant that LCMS (learning content management systems) were a combination of LMS (learning management) and CMS (content management) systems and that content management systems provided the content component to the learning management system. Learning management systems (LMS) routinize "the administration of learning/training programs within an organization" (¶ 3) by helping administrators target, provide, analyze, use and report on learning endeavours, and by helping employees plan their learning progress and consult with their peers. In online publishing, content management systems (CMS) are used to coordinate and ensure consistency in the creation and administration of online content whether in text or other symbol systems, such as are visible in reading financial or technology news sites. The system depends on the information provided in content components by a variety of writers and designers. For Nichani, each content component is somewhat akin to a reusable learning object (RLO) when the component is the smallest independent instructional experience that contains an objective, a learning activity and an assessment (p. 4). Put together with a learning management system, individual learners could choose or request information contained in the learning management system that had been meta-tagged as targeted to their interest, included "just-enough learning" and provided an immediate response. While we may disagree with the construction of knowledge this model represents, it provides us with an example

of how some envision the use of reusable learning objects within a virtual learning environment.

Jonassen and Churchill (2004) took strong exception to this vision of reusable learning objects. They argue that "this is a model for learning about some content" (p. 34) not about knowing or understanding how to do anything, and contend that individual information objects, even when clustered, are insufficient to achieve learning. They base their argument on the belief that "Learning relies on personal and social agency, activity and reflection" (p. 33). This underlines the importance of intentionality and activity, first that "meaningful learning cannot and will not occur unless and until the learner becomes aware of and (preferably) articulates an intention to learn" (p. 35) and second that "learning objects must be tied to learning activities, rather than used independently from the activity" (p. 37).

2.3   Developments in the K-12 sector

In 2003, there were very few collections of learning objects in the K-12 sector; since that time, there have been some significant developments in the UK and Europe. However, while the development of school level databases is welcomed, the barriers to teachers' use of ICTs have received most attention.

European SchoolNet (www.eun.org) is a partnership of over 26 European Ministries of Education interested in the educational use of ICT (information and communications technology) in Europe for policy-makers and education professionals. Based on the Canadian SchoolNet (www.schoolnet.ca), it coordinates discussions and activities among teachers, students, policy makers and commercial vendors. One of their initiatives was CELEBRATE (2002-2004).

CELEBRATE (www.eun.org/ee/en/pub/celebrate_help/) was a large scale project designed to examine how learning objects can enhance teaching and learning in European schools. It was funded by the European Commission's Information Society Technology program (IST) and includes ministry personnel, university researchers, large educational publishers, content developers and technology suppliers. "Its key aim is to provide a large-scale test-bed or practical demonstration of how schools from across Europe can use, adapt, reuse and develop Learning Objects" (¶ 5 FAQ). In addition to examining how schools reacted to learning objects, the project also proposed business models for the development, exchange and purchase of learning objects. In the demonstration phase (January 2003-May 2004) teachers accessed reusable learning objects, and also the tools and a virtual learning environment to make their own objects, build courses, and communicate and collaborate with other developers. Over 1400 learning objects and 25 simple authoring templates were developed by commercial publishers and Ministries of Education. They were mainly in Mathematics, Science and Language with smaller numbers in other subjects. While assessing the demonstration project as generally successful, the

evaluation team (McCormick, Scrimshaw, Li, & Clifford, 2004) concluded that the program would be sustainable, "only if at each stage of its development:

- sufficient teachers want to use LOs;
- sufficient LOs are produced;
- the ones produced are the ones that are wanted;
- and the teachers are able to find and successfully use the LOs they want." (p. 157)

Besides participating in European SchoolNet, some countries are also developing their own digital repositories and evaluating and testing learning object implementation with teachers. One example is LT Scotland (Learning and Teaching Scotland). A national public organization sponsored by the Scottish Education department, it is responsible for guidance on curriculum and ICT in schools, professional development, and promotion of lifelong learning. Under the Scottish Schools Digital Network, LT Scotland plans to provide broadband access to all 3000 schools and promote use of learning objects (Duncan, 2003). They were involved in ITALES (Innovative Teaching and Learning Environments for Schools) (www.itales.ltscotland.com), a three year European Union-funded project to develop a 3-D virtual school portal that provided authoring tools for teachers, a course repository, and e-learning course access to teachers and students. The project finished in June 2004.

In the UK, the impact of ICT on schooling has also received considerable emphasis. Several studies concerning effective use of ICTs in schools have been undertaken. In 2003, Becta, the British Educational Communications and Technology Authority (www.becta.org.uk), commissioned two studies on factors affecting teachers' use of ICTs. From a study on barriers to teachers' use of ICTs, Jones (2004) identified the following key findings:

- Confidence, time and access to quality resources are major factors in deciding teachers' engagement with ICT. Confidence was closely related to factors such as amount of personal access, available technical support, and extent and quality of available training. "In particular, teachers who do not realize the advantages of using such technologies in their teaching are less likely to make use of ICTs" (p. 4).

- Recurring technical faults, and the expectation of faults occurring during teaching sessions, are likely to reduce teacher confidence and cause teachers to reject technology in future lessons

- Resistance to change prevents the full integration of ICTs in the classroom. This may apply to teachers who are reluctant to change their teaching practices or to schools which are unwilling to reorganize to "facilitate innovate practices involving ICT" (p. 4).

A parallel study of enablers of educators' ICT use (Scrimshaw, 2004) sought to identify school based and externally based strategies that encouraged successful use of ICTs. Key school-based strategies identified were engaged leadership and focused planning, a whole school approach to sharing of resources, reliable technical support, and significant professional development. Key external enabling strategies were teaming and school-community cooperation, differentiated locally-based training, electronic teacher networks and teacher involvement in national ICT initiatives. (pp. 5-6)

Becta also commissioned studies on student motivation, on ICT and attainment, and on ICT and pedagogy. A study on the motivational effect of ICT on students' learning (Passey, Rogers, Machell & McHugh, 2004) found that "ICT use by pupils and teachers in the case study schools led to positive motivational outcomes, supporting a focus upon learning and the tackling of learning tasks" (p. 3). The authors also noted that motivation was more positive when ICT was used for learning as well as teaching rather than for teaching alone, and that use of ICT was motivational for both boys and girls and encouraged persistence in boys. Previous motivational research results concerning multimedia have been mixed and no comprehensive model which includes all the major factors to be considered in developing multimedia learning environments has been tested (Astleitner & Wiesner, 2004).

The attainment study (Cox, Abbot, Webb, Blakeley, Beauchamp, & Rhodes, 2004) provided evidence of strong links between ICT use and attainment in English, mathematics and science with the researchers concluding that "the crucial component in the appropriate selection and use of ICT within education is the teacher and his or her pedagogical approaches" (p. 3).

This was reiterated in the study on ICT pedagogy (Cox, Abbot, Webb, Blakeley, Beauchamp, & Rhodes, 2004);

> *When teachers use their knowledge of both the subject and the way pupils understood the subject, their use of ICT has a more direct effect on pupils' attainment. The effect on attainment was greatest when pupils are challenged to think and to question their own understanding, either through pupils using topic-focused software on their own or in pairs, or through a whole-class presentation.* (p. 3)

A number of other studies are underway. For example, InterActive Education (www.interactiveeducation.ac.uk), a funded project at the University of Bristol, "aims to examine the ways in which new technologies can be used in educational settings to enhance learning" (¶ 4). In countries such as the US (Bosco, 2003) and Canada (Gibson & Oberg, 2004) researchers have raised concerns about the disconnect between the potential and actual use of ICTs in schools.

Besides the studies focusing on students and teachers' use of ICTs, Becta also undertook a number of studies involving broadband, virtual learning environments (VLEs) and learning object repositories. The Broadband study (Underwood, Ault, Banyard, Dillon, Durbin, Golland, Hayes, Selwood, Somekh, Twining, & Woodrow, 2004) examined the impact on teaching and learning in schools that had at least 2mbps of connectivity. They concluded that the response was generally positive, the impact on students' learning was not immediately evident (performance two years following installation increased significantly at CGSE/GNVQ level), costs of implementing and maintaining effective connectivity were significant, and there was variability in the knowledge and skills of staff.

Much of the work on virtual learning environments has occurred in higher education settings but the level of interest shown by Becta (2004a) reflects a more general interest: "Although VLEs are still relatively new to the schools market, the general impression is that they are likely to have a significant impact on the process of teaching and learning in the future" (p. 2). Hunt, Parsons and Fleming completed a review of research on the use of managed learning environments and virtual learning environments in 2003. They defined a VLE as a software tool that brings together in an integrated environment, a range of resources that enable participants to interact online, and includes content modules and tracking of student activity and achievement. Most course management systems such as WebCT or Blackboard would be VLEs. The managed learning environment (MLE) adds a management information system to the VLE with links to other administrative systems such as student timetabling, library and the student record system. Interoperability of the systems is the key. This has been a relatively recent definition (JISC 2000) and is not in common use even by commercial vendors hence the generic term, VLE, is most commonly used. The researchers note that the interest in VLEs is likely to increase because of the development of *Curriculum Online* by the UK Department for Education and Skills (DfES) (www.curriculumonline.gov.uk) and the e-Learning Credits scheme where "L100 million per year of e-learning credits is being made available to schools in 2004-2006 to spend on digital learning resources" (p. 40).

The issue of the integration of learning platforms in schools was the starting point for a study on organizational learning and sustainability in the integration of ICTs in schools carried out by McClusky, Hofer and Wood (2004). The writers concluded that interviewees saw three factors as central to the professional learning of school staffs: "personal experience, intensive networking and a positive attitude to change" (¶ 2) but they thought that the present culture of schools was too judgmental to be supportive of any of these. The development, use and implications of a learning object repository, *Kaleidoscope*, was also the focus of research. The findings document the importance of various factors such as clear learning outcomes, communication, leaders at both the senior administrator and teacher developer levels, the need to achieve a critical mass quickly, and the involvement of communities who already share materials. In

terms of wider policy lessons, Thomas and Horne (2004) see the tensions between individualized instruction and student collaboration and between individual student and school performance assessments as problematic to the values of personalization and collaboration. They recommend the promotion of digital resource creation as craftsmanship for teachers, embedding resource creation and sharing into teachers' professional identity, trialing new forms of assessment, encouraging hybrids between commercial and home-made teacher resources, and exposing policy makers to teacher practices through learning objects (pp.34-5).

Although the writing on VLEs expands, the tensions remain. On one hand are those who see VLEs in the future as responding to a learner's need by providing learning objects at the appropriate level of learning and allowing the learner to pick and choose what and how much they want to know, without the intervention of a teacher. At the more extreme end of this view is the commercialization of VLEs and learning objects and the proposition that in a new object economy these would be widely traded. An alternative view is where the desired involvement in VLEs is learners' active engagement with learning materials based on learner interest. At the more extreme end of that view, students create objects and construct their learning collaboratively. While at the centre point the two views might seem quite close together, it masks the continuing tension around context. In the first two examples, context is minimized, information is seen as generic, and access to information will lead to learning; in the second two examples, context, especially the social context is crucial for learning which is seen predominantly as a participative activity rather than a purely cognitive one, facilitated by a teacher where information is shaped by the learners' prior knowledge and understanding and the local situation, and where learning is personalized and only occurs when there is a will to learn (Parrish, 2004).

3. Pedagogical concerns

These same tensions are present in the different approaches to development of learning objects. Some propose a pragmatic approach, blending different approaches while others insist on a purist view. All the characteristics discussed in the previous paper (Muirhead & Haughey, 2003) remain topics of interest to various groups.

3.1 Characteristics

Reusability has been of major interest and has had most press this last year. Metatagging and the issues surrounding it and instructors' general unwillingness to complete or even undertake the comprehensive metatagging the committees deemed essential for sorting were discussed and various suggestions made from explaining to developers why the metatags were important to trying to streamline the list and identify those tags most appropriate for the particular context.

Basically, writers suggested that rather than search a data base, teachers planned to use only their own objects or those of close colleagues, and hence ignored the admonition to classify their learning objects.

Scope received less emphasis; in most of the pilots, the necessity for a rich complex learning environment won out over context-neutral items. Size suffered a similar fate; while some writers continued to insist that the smallest instructional unit was preferable, the actual size of learning objects used in the various projects ranged from single images to entire courses. While aggregation was mentioned as a positive outcome of learning object use, we found few examples of it in practice. Localization, in particular the specifics of the cultural context, continues to receive relatively little press. It is identified obliquely in references to the importance of context in constructivist approaches, but not discussed directly.

Brown, Miller and Robinson (2003) did examine the development of learning objects in relation to elementary students with special needs. Three teams of graduate and undergraduate students interested in instructional design were paired with classroom teachers for a year. The groups designed and developed three flexible learning tools in cooperation with their teachers. The teachers were pleased with the materials and saw them as appropriately flexible to be used in a variety of situations. However, one major motivating influence for the students was their discovery that one of the researchers was an expert in one of the software packages being used.

Although Brown and her colleagues found that providing a team of graduate and undergraduate students interested in instructional design to work with classroom teachers resulted in appropriate and effective learning objects, this was not the case for Kovalik (2003). In the project she describes, undergraduate students were assigned to design and develop technology-enhanced instructional units on a prescribed curriculum topic chosen by a classroom teacher. The results were very uneven with most teams designing teacher-centered materials, and using technology in predictable low-level ways. The overall low quality suggested that undergraduate students did not have sufficient skills to transfer what they knew from their course work to the development of appropriate learner-focused materials. The presence of the highly skilled technology user as a researcher in Brown, Miller and Robinson's work is further highlighted. This suggests that not only technical assistance but the ability to illustrate the advanced capabilities of the software to encourage creativity are of importance to teachers were they to attempt to undertake this themselves.

4. Designs for learning objects

Writers continue to try to clarify the issues between constructivist and behaviorist approaches to learning object design. Deubel (2003) explores both approaches and outlines their basic concepts and characteristics. She concludes that despite

their differences both have many similarities. They both "involve analysis, decomposition, and simplification of tasks to make instruction easier and more efficient" (p. 73) and they both seek to arouse the learner's attention and to sustain engagement through interactive decision-making and giving intrinsic feedback. Further, she suggests that while constructivist models appeal to teachers because of the need to engage and motivate a diversity of learners, "the accountability movement in education with its focus on identifying what students must know and be able to do and assessing students for mastery forces designers to write explicit objectives and criterion-referenced test items" (p. 86). Because of this she suggests that designers "identify explicit objectives based on learner needs, but use instructional strategies that promote learning and content mastery in authentic settings" (p. 87).

4.1 Instructional Design

Although Deubel (2003) stresses the importance of the underlying pedagogical principles, still lacking, in her estimation, is a model that is useful in examining learning in multimedia environments. When designing for effective learning with multimedia, the principles used are made manifest through the interface design. Duebel provides eight rules taken from Kenworthy (1993) as a guide to high quality interface design. She proposes that designers should keep the cognitive load appropriate to the age and grade level of the learner. They should avoid dividing attention between competing text and graphics (auditory rather than textual information should accompany images). While earlier work suggested that only cognitively advanced students benefited from multiple representations, these are required for those with disabilities. Colour, icons and animations should direct attention and enhance communication, important information should remain visible or easily accessible through concept maps, table of contents, etc., and practice exercises to encourage rehearsal are valued. Other rules involved designing effective exercises that helped reinforce and sustain interest, using concrete words with audio support for description of abstract terms, and creating realistic simulations.

In addition, she stressed the importance of scaffolding evident in the universal design for learning approach (Pisha and Coyne, 2001) which is based on Vygotsky's three conditions: the involvement of the recognition, planning for action and affective engagement for learning. The influence of universal design principles on learning objects is just beginning but is likely to have increasing impact on learning objects in the K-12 sector. The advantages of flexible and fade-able scaffolding were raised by Luckin (2001) in her study designed to ensure interactivity through collaboration in Vygotsky's zone of proximal development. She found in working with 10 and 11 year-olds, that such scaffolding was essential since children were not effective at setting themselves challenging tasks or seeking appropriate assistance. These aspects of appropriate scaffolding, encouraging persistence and asking challenging questions were also identified by Arthur and her colleagues (2001) in their study

of effective e-learning environments for young primary school children. This would suggest that these aspects need to be included for learning objects to be effective.

Hedberg proposed (Hedberg, 2004; Hedberg and Sims, 2001) that we need new forms of "design dialogues" among classroom teachers, instructional designers, programmers and learners in order to ensure successful learning environments. The dialogue would provide "a narrative encounter in the design dialogue" between learner and object and result in higher levels of collaboration for the design team and more engagement and interaction for the learner.

An alternative approach which would provide teachers with the skills to design their own learning objects has been proposed by a number of writers. Dunning, a Dean of Continuing Studies at Indiana University decided to develop templates reflecting a variety of learning styles that would allow his staff to create their own objects with minimum frustration. Referred to as the TALON (Teaching and Learning Oriented Network) system, it contains a variety of items such as drag and drop exercises where the instructor is easily able to visualize replacing one set of information and accompanying labels with another (Dunning, Rogers, Magjuka, Waite, Kropp, Gantz, Kaur, Vidali, Hunt and Vandermolen, 2004). Ron Jones (2004) also proposed the use of learning object patterns to encourage reuse through design. In order to resolve the tension between the need to be context-free in order to maximize reuse and the need for context to make it relevant for learners, Jones proposed that objects be partly context-free but with expansions that would be context-specific. In this, he was building on the work of his colleague Tom Boyle (2003) who proposed the single web page for generic content and associated links to allow for expansion, examples, and related materials.

While providing assistance to teachers to design their own objects may result in simple tasks being automated so that appropriate design elements are included without the requirement that the teacher be even cognizant of the technical design issues, this does not address the development of complex learning environments. Underlying the premises of constructivism is that learners are engaged in authentic learning environments where they are not only able to make choices but to construct their own learning in personally meaningful ways. Scaffolding is mentioned frequently because it is a means to help support the learner through this complexity while giving them maximum control. In a virtual learning environment, simulations are often considered to be the most effective way of reaching these multiple goals. Harper, Squires and McDougall (2000) see simulations as a new design paradigm which can achieve these multiple goals. Through a review of the use of two simulations with students that included both experiential and symbolic simulations, they found that learners wanted more simulations with greater fidelity to real world situations and also more opportunities for symbolic manipulation. From this, they proposed that the design framework for experiential simulations should address the three constructivist

concerns for complexity, credibility and ownership. The advantage of the inclusion of greater numbers of symbolic manipulations was that they allowed students to work with highly complex situations without succumbing to uncertainty and hence to be better able to work back and forth between the experiential and the symbolic.

The use of the experiential in simulations is supported by the work of Berg (2000) who proposed storytelling and narrative as an appropriate approach to interface design. He reviewed the use of narrative in film theory including the impact of New Wave directors who forced audiences to look beyond the film story and see the story as a construction using the narrative language of film. He reviewed studies in educational psychology where learning was based on Bruner's conception of meaning-making in a cultural context and examined the Meno project (Laurillard, 1997) undertaken by Laurillard's group at the British Open University in relation to computer interface design which explored Meno's paradox of how to learn something you know nothing about. From these analyses and associated research, he concluded that presenting content in narrative form increased comprehension, that instructional designers should use film narrative conventions to take advantage of an already established meaning code, that stories should be told from multiple perspectives to ensure critical reasoning, that learners should have the opportunity to re-create their own stories based on the external narrative and their own experiences, that learners see their learning as meaning-making and that the relationship to community (i.e., the viewers) not be ignored in interface design (p. 15).

While Berg developed his recommendations from the literature, Voithofer (2003) employed a critical analysis of Online Quest experiences (1998-2000) to propose a framework for using narrative theory to guide the design of educational multimedia. In doing so, he sought to link together learning theories and instructional design theories with cultural theories of pedagogy which "address the relationships between the intersections of race, class, gender, ethnicity, geography, profession, and nation with learning" (p. 69). Not only was critical narrative theory useful in identifying various ways learning narratives might be analyzed but it helped identify the implications of messages embedded in structures and images.

4.2 Assessment

E-Assessment has been a topic of interest for almost the last twenty years. As technical knowledge has grown, national bodies have developed databases and explored the use of online examinations, and institutions have considered the use of formative e-assessment to enhance the authenticity of the assessment experience for learners. Most of the recent work has been focused on large-scale assessment given the move internationally for large scale testing across various populations. Ashton, Beevers and Bull (2004) provide a review of developments, particularly in Scotland where they are attempting to develop a national

assessment scheme which would "achieve automatic delivery" of test items to schools and colleges. In an inquiry into the reliability, efficiency and quality of examinations for the UK Department of Education and Skills, Tomlinson (2002) also examined the potential impact of ICTs and recommended increasing ICT use in the administration and marking of public examinations and eventually in the examination process itself (¶ 6).

Concerned that the principles of constructivist learning conflicted with traditional assessment practices, Pedersen and Williams (2004) examined three different forms of assessment practices in a grade 7 classroom (13-14 year olds).Their results were inconclusive. The students all enjoyed the science unit and felt their grading on in class assignments had been fair. The grade itself then was not a motivator and students were unconcerned by the different forms of final assessments (problem-solving and factual recall).

McCormick (2004) in his review of ICT and assessment as part of the ERNIST project comments that practices have been ahead of research in both assessment and ICTs and argues that the traditional formats used are inadequate to our knowledge about learning and, in particular, with ICTs. First, he reviews traditional summative assessment practices and reiterates the concerns about a focus on low level cognitive recall rather than assessing the extent to which the learner can act like an experienced learner in that discipline or subject, in ability to think, solve problems and access algorithms, all of which can now be assessed using ICT. However, he acknowledges that there are several major initiatives by various government bodies in this area that bear monitoring. (See the National (UK) Council for Educational Research website http://www.nfer.ac.uk/research/cba.asp). He also points out how the new developments with ICTs and networks now provide other important areas for research and identifies one as the assessment of the advantages of collaboration with peers as part of the construction of shared knowledge. He also notes that learning to collaborate is another area that has not been explored.

Overall, the literature on learning objects is changing focus; as more people become involved in trying to actualize what has been standardized, issues as varied as repositories and assessment have come to the fore. The fundamental concerns about ensuring that learning is not reduced to information acquisition remains but with actual practice, more people are recognizing the potential of ICTs and virtual learning environments. As Parrish (2004) notes,

> *To the extent that the learning object movement can foster effective learning by introducing active learning experiences, supporting student-centered learning environments, propagating new ideas about instruction, and increasing collaboration and sharing of resources, it can play a major role in improving education and training.* (p. 65)

4.3 Reactions of teacher users

For learning objects and VLEs to move from the margins to the mainstream, there needs to be a sufficient and stable infrastructure and a general level of teacher competency and comfort with ICTs. Much of the discussion in the literature seems to assume that teachers are knowledgeable about ICT use and schools are technologically well served. The writers manage to avoid recognition of the uncertain levels of infrastructure, the small numbers of computers easily accessible by teachers and the general low level of ICT use in teachers' classrooms. A number of countries have undertaken studies to examine ICT use in the classroom. Recent studies, for example in Canada (Gibson & Oberg, 2004) and in England (Becta, 2004), stress the importance of general teacher comfort with integrating technological applications into classroom procedures.

One of the few studies which examined use of learning objects specifically, was the CELEBRATE (**C**ontext **e-le**arning with **br**oadband **te**chnologies) project (McCormick, Scrimshaw, Li, & Clifford, 2004). This demonstration project was funded by the European Commission's IST programme and coordinated by European SchoolNet. It included stakeholders from the public and private sectors including governments, universities, content developers, software vendors and technology suppliers. The research team used a range of questionnaires and interview and classroom observation studies to address the major questions concerning teachers' interest in and use of learning objects, whether learning objects supported innovative forms of teaching and learning, and whether a pedagogy based on collaborative learning to create and use of a critical mass of learning objects within VLEs was possible. Other questions addressed the use of interoperability standards, technical solutions to exchange and purchase of learning objects between Ministries and the viability of business models for learning object content development and distribution.

Of the large number (1400) of learning objects created, about one-third were judged suitable for trialing in classrooms. The teacher developers used a number of authoring templates and had sufficient face-to-face training to suggest that this method may not be scalable to all. The researchers also found that "the vision of teachers each modifying learning objects for their own use did not generally appear" (p. 131). While they had hypothesized that learning objects would be produced only by central agencies or individual teachers, they found that a team model was the most successful in producing large numbers of "acceptable quality" (p. 131). Successful teams had "members with expertise in programming, classroom teaching with ICT, and subject knowledge" (p. 131). They found that teachers were generally pleased with the quality of the learning objects but had "some reservations about the flexibility and usability of learning objects" (p. 132) and some had technical difficulties related to their own infrastructures. Some teachers had reservations around pedagogy and felt that it required too much work to integrate learning objects into their teaching. The researchers felt that this was due more to the teachers' low level of technology skills and lack of

knowledge about how to use learning objects rather than to a basic lack of pedagogical experience. Despite this, the researchers also acknowledged that the teachers involved in the project were in general more experienced with ICT than their colleagues.

McCormick and his colleagues also found that students were generally interested in ICTs and Learning objects worked across year levels, age ranges and subject areas. Teachers thought use of Learning objects enhanced motivation although the team did not gather any concrete evidence of this but in a smaller study on attainment the researchers "found robust evidence that they(learning objects) can be more effective than traditional teaching" (p. 133). In terms of their use with a variety of pedagogical models, the researchers noted: "There is an interplay between the affordances of a learning object's pedagogy and the pedagogical practices the teacher is able to construct, given her pedagogic competence in using learning objects, and her underlying conceptions of learning" (p. 134). Part of the project was to create learning objects based on constructivist pedagogy. In their assessment, the researchers found that most objects were not clearly constructivist; many were drill and practice, but that teachers "were able to create elements of advanced pedagogy in their classrooms" (p. 139). They concluded that learning objects "can enhance active learning by students, collaboration, authentic material and activity, and provide multiple perspectives on knowledge. It is clear that the focus of control or design of pedagogy is in the hands of the teacher" (p.134). In sum, the learning objects themselves were not constructivist in design, but some teachers used learning objects in constructivist activities in their classrooms.

As learning objects have been released, The Le@rning Federation has undertaken a number of studies to acquaint teachers with them and to obtain their initial reactions. Five information sessions were held in conjunction with various teacher-oriented conferences over a five month period in 2004. Participants were introduced to the 35 learning objects and to the principles behind their development and then given time to explore them and discuss their utility for their teaching. Participants were asked to complete a survey formalizing their reactions to each learning object. The data from the five sessions were aggregated (Snapshot 1, 2004).

In all, 75 surveys were completed; participants filled out the online surveys in small groups of one to three members so it is possible that as many as 225 educators were involved. Overall, for 60% of the learning objects, educators thought that they were "extremely" or "more than likely" to use them with students and for another 24%, respondents thought that they would "probably use" them. Despite the likelihood that those who chose to participate may already have felt positively about the use of learning objects, this would indicate that those who participated were generally impressed with the materials and saw their use as an asset to their teaching. This conclusion was also reflected in the open-ended responses, where some groups provided nuanced and specific suggestions for

integrating the objects suggesting that they were easily able to visualize their use in the classroom. The mathematics objects engendered the most interest with literacy second and science third. The groups identified possible key learning areas for all 12 of the mathematics and numeracy objects, for eight of 12 of the literacy objects, and for eight of 15 of the science objects. There is no way of knowing if this reflected personal choice, background of participants or earlier information at the workshop.

A second snapshot of responses (September, 2004) reflected the opinions of 22 teachers and two SEA officers involved in an introductory workshop prior to trialing the objects in their classrooms. This workshop ran for most of a day and teachers working in pairs had the opportunity to review 30 learning objects and participate in a general discussion of their utility for their classroom teaching. The remainder of the time was spent in assessing the implications of implementing the online content in their particular contexts as part of the trial.

The same online survey was used but two questions about the likelihood of the objects to engage their Aboriginal students and contribute to those students' learning outcomes were added. The participants examined 36 objects during the workshop, suggesting that the 12 groups each examined about three objects on average. For each object they reviewed, the group indicated whether they were likely to use the object with their students. Four learning objects were rated "extremely likely" to be used, another 15 were rated "more than likely", and a further 12 were considered to be "probably" used with students. Over half were judged as having a high likelihood of use and 31 of 35 were at least "probably" going to be used. Since these teachers were part of the trial, and the groups were formed across disciplines and year levels, these indications are more likely to reflect an assessment of actual intentions than possible future actions. Like educators in the previous groups, a number gave detailed and specific descriptions of potential likely use.

The large majority of objects (29 of 35) were considered suitable for engaging Aboriginal students and a similar number were considered as either "significant" or "useful". The concerns among those who did not agree that the objects would be engaging to Aboriginal students ranged from assessments that the language level might be inappropriately high, the content seemed too limited and simple to retain their interest or was too text based requiring extensive reading, the item lacked relevance to the students' lives, or was too complex and required too much prior knowledge.

The Federation also initiated a field review of learning objects in March 2003 to evaluate their pedagogical applications and obtain feedback about their use by teachers and students and their impact on teaching strategies and learning outcomes. In response to a general call for participating schools, 12 schools from five Australian states and territories, and two schools from New Zealand were identified as the case sites. In all, 20 classrooms in the 14 schools were visited.

The low response prohibited the use of a stratified random sample, and most volunteer classrooms were in the middle to upper primary years. Assumptions about use were further compromised because 9 of the 20 teachers were not familiar enough with learning objects and web technologies to be able to integrate them into their lessons (p. vi). Nonetheless, using a combination of classroom observations, surveys and interviews with students and teachers, the report team (Lake, Phillips, Lowe, Cummings, Schibeci, & Miller, 2004) provided a range of very valuable data. This pilot provided positive preliminary feedback on the students' engagement with the objects. Being able to regulate the pace of their learning, to choose how to proceed and to loop backwards through the object were positive aspects for learners suggesting the importance of providing alternative sequences even in a linear argument or problem-solving design. This also provided for different levels of difficulty which enhanced the value of an object for the teacher. In a number of objects, the necessity of text and its possible overlay with audio need to be reviewed.

The researchers reconfirmed that "teachers' beliefs about teaching and learning influence their choice and use of learning objects" and found that "while teachers were eager to exploit new learning opportunities offered by learning objects, some teachers replicated acceptable, inexpensive classroom activities", Some teachers thought that the experience had caused them to view their curriculum in new ways, to consider different approaches to learning and "prompt[ed] them to reconsider their assumptions about teaching and learning" (p. 86)

Further research would assist The Le@rning Federation to ensure that learning objects are meeting, over time, the goals set out for enhancing learning outcomes. Different kinds of research are essential so as to identify the level of teacher use and comfort with learning objects, the enablers and barriers re teachers' use of ICT and learning objects, the effects of use of ICT and learning objects on teachers' practice and student learning outcomes, the relationship of use of learning objects to teachers' pedagogy, extended student feedback on the design and motivational aspects of learning objects, an assessment of the various organizations' capacity to support effective and efficient access and use of learning objects, and the most effective ways to enhance use of learning objects in the classroom. While the research mandate is outside the current terms of reference for The Le@rning Federation, it is vitally important that the unique opportunity build new understandings from gathering data and making observations surrounding learning object development and their use within schools not be lost. Such research can only add to an appreciation of the leading edge developments undertaken by The Le@rning Federation.

4.4 Continuing professional development

The importance of helping teachers transform or enhance their teaching through the use of ICTs has received recent prominence in a number of countries. In the US the Department of Education's (2005) recent national educational technology

plan, contains seven major action steps and recommendations for US schools. They include a greater emphasis on e-learning and virtual schooling, teacher training, broadband access, digital content, innovative budgeting, strengthened leadership and integrated data systems.

In the UK, Becta has turned to a professional development initiative to help enhance ICT use. Besides, issues about regular upgrading and maintenance of equipment, Gibson and Oberg (2004) stress the need for professional development funding and explain that this may be the point at which professional development is most useful; "Earlier, there were issues of capacity and access however many teachers who regularly use the Internet used it for information retrieval rather than for development of creative thinking and problem solving. Well-designed learning objects can help teachers familiar with the basics of technology meet their learning goals in a defensible pedagogical fashion" (¶ 3).

The literature on professional development in relation to ICT is very broad but studies focused on the integration of learning objects are actually few. In terms of professional development, McCormick and his colleagues (2004) concluded that "the use of learning objects requires experienced teachers to develop new pedagogic competencies that may require teachers to share practice" (p. 142). They also decided that teachers needed to develop "new ways of working with learning objects that do not currently exist, and so the idea that there is an "expert" teacher out there somewhere who could train teachers to use them is not a good model to work with" (p. 142). Instead, they strongly encouraged the use of real teaching scenarios "which can demonstrate convincingly the effective use of learning objects in teaching and learning" (p. 145). They also found that it was necessary to train content developers concerning learning objects.

As the teachers in The Le@rning Federation's Stage 1 pilot suggested, professional development support needs to be timely, specific, targeted and hands on. One suggestion is to consider the development of a League of Innovative Schools such as was done in the European SchoolNet following the Canadian model. The schools in this network not only are the test sites for new objects but they also cooperate and share professional development opportunities among the schools in the network. In addition, a teacher in the study raised the potential value of an electronic 'learning exchange', a community of practice model for exchanging ideas about use of particular objects. Teachers relate to other colleagues through subject or age-level taught and so networks that involve actual working with colleagues as well as electronic networks among groups of teachers based on these characteristics have been found to be successful (Sandholtz, 2001; Selinger, 1998). This initial level of cooperation may then spin off other more extensive in-service opportunities such as the metacognitive approach proposed by Phelps, Graham and Kerr (2004).

5. Quality Instructional Design and Quality Assurance

The Learning Federation sought expert advice and guidance on the topic of quality instructional design--a strategic priority of the organization. Specifically, the researchers were asked to address the following question:

"In light of international practice, what are the arguments for and against retaining the Learning Federation focus on 100% quality in instructional design?

In addressing this question, it is important to acknowledge that an examination of instructional design cannot occur in a vacuum. It involves the consideration of many inter-related factors including notions of excellence; design and implementation of standards and quality assurance processes; age-appropriate teaching strategies; use of information and communication technologies for learning; and the role that learning objects can play in school settings to enhance learning outcomes. Further, an examination of quality instructional design often extends beyond notions of excellence in education to address philosophical issues surrounding technology, digital content and business practices.

5.1 Key Informant Interviews

To answer the question pertaining to quality instructional design, the researchers conducted in-depth key informant interviews with eight senior managers from The Le@rning Federation. These individuals were identified through discussions with the Learning Federation Secretariat and the General Manager of the project. The face-to-face interviews were conducted in Melbourne in November 2004. The interviews were audio-taped with the consent of the key informants. A semi-structured interview guide was used to organize questions thematically (Appendix 3). The questions solicited insights into current challenges associated with The Le@rning Federation operations; lessons learned in the development of digital materials; quality assurance processes used by The Le@rning Federation; potential opportunities for commercializing learning objects; comments on learning object design; and future directions for The Le@rning Federation.

5.2 Document Review

The researchers reviewed key internal and public documents in areas pertinent to the study. Documents were reviewed on the topics of learning object design, setting standards for development and quality assurance processes. They included:
> *Quality Assurance Framework for Online Course Development Version 3.1*
> *Educational Soundness Specifications Version 2.2*
> *Consideration for Learning Design*
> *Learning Object Accessibility Approach Version 2.1*

Accessibility Specification Version 2.0
Achieving Educational Soundness in the Digital Age

Further, the researchers reviewed documents pertaining to the design and development of technical standards to ensure that learning objects were usable and sustainable. These included:

Technical Specification for Content Development Version 3.2
Metadata Application Profile Version 1.3
Metadata Mandatory Elements Version 1.1

Additionally, key documents were reviewed pertaining to the development of learning object repository specifications to ensure that learning objects can be housed, managed and distributed to learners throughout Australia and New Zealand. These included:

Learning Object Repository Access and Exchange Version 0.4
Rights Management Specification

6. Quality Instructional Design: An Overview

Quality instructional design involves an examination of four components: Instructional Design as Standards-Based; Instructional Design as Quality Assurance; Instructional Design as Capacity-Building; Instructional Design as Primary Research. The interest of The Le@rning Federation in quality instructional design is to ensure that learning objects are well designed. Further, learning objects must be free from factual error, incorporate navigation and design features to allow their use by all students, and meet international standards. In addition, The Learning Federation places emphasis on instructional design principles to ensure that learning objects incorporate pedagogy to make certain that learning objects support best teaching practices. Through the interview process many key informants spoke passionately about the need for learning objects to represent current thinking about the specific subject matter. They felt this would prevent misunderstandings or potential "educational harm" to learners. Finally, key informants maintained that an emphasis on instructional design would address the differences between local and international curricula. Staff felt that without a highly focused orientation towards instructional design, The Le@rning Federation could have easily become mired in mis-directions, missed opportunities, or missed targets. The four components of "a 100% focus on instructional design" help to explain the interplay between instructional design and foundational facets of learning object development.

6.1 Instructional Design as Standards-Based

The approach to instructional design adopted by The Le@rning Federation was to develop and document specific "standards" for the project. Standards were created to ensure conformity to the pedagogy incorporated in all learning objects. Standards also ensured that when conflicting considerations arose when choosing features or approaches to learning object development an agreed upon standard would direct required decisions. The standards for educational soundness, technical design and quality assurance were augmented in concert with other standards concerning accessibility by learners with disabilities. Accessibility standards or guidelines were also created to address educational context that is rarely value free and which often incorporates cultural "footprints". The Le@rning Federation designers, writers and the development community expended considerable energy in efforts to avoid any cultural biases in learning objects.

The approach to development and codification of standards was an important first step to ensuring that all learning objects met a Le@rning Federation "minimum" standard. It cannot be overstated that this early focus on research and wide consultation focused on developing standards through collaboration contributed to a "consultative overhead". This added requirement to consult widely will be explored in greater detail later in this report.

In part, due to the unique position that The Le@rning Federation occupies nationally and internationally, there are no similar programs to serve as a comparison. Therefore, the standards developed (based on emerging international standards, predominantly from the training or postsecondary sector) must be considered the "current state of the art" for the schooling sector. While LearnAlberta.ca is a project to develop and deliver multimedia content and learning objects to school-aged students, its most recent emphasis on repurposing existing multimedia content, digitizing media from traditional media companies (for example, National Geographic) and distributing content through a closed repository structure or through the use of secure distributed servers on local area networks makes comparisons unworkable and consequently does not provide a benchmark.

Researchers feel that the development of standards documents to inform practice is the correct approach. Moreover, the multiple versioning of the documents signals an understanding that learning object development and learning object standards are rapidly evolving areas and that standards are living documents reflecting "current thinking". Therefore standards cannot be static or inflexible.

6.2 Instructional Design as Quality Assurance

As of January 2005, The Le@rning Federation has developed 403 learning objects (prototype or beyond) and is reported to be well on its way to developing 4600 content items by June 2006. To coordinate such a rapid development cycle across major curricular areas and age levels required assistance from jurisdictional curricular consultants. Using advisory groups such as the Curriculum Area Reference Group (CARG), obtaining input from Expert Focus Groups (EFG), and involving user focus groups (UFG) in the development and field testing of learning to ensure content is viable in disparate instructional settings is both organizationally complex and requires significant work to administer. This is even more important when groups have unequal understanding and familiarity with learning objects. In addition, complexity is inherent in all Le@rning Federation activities when it undertakes to coordinate the work flows from design to publication while overseeing the adherence to standards by external developers. To meet expectations regarding instructional design it is necessary to develop quality assurance work processes with the appropriate measures to ensure consistent instructional design. Therefore, it is not surprising that instructional design as quality assurance is the "100% focus" of The Le@rning Federation.

One area where change has been made since the Phase One Review pertains to The Le@rning Federations decision to directly contract subject matter experts (SME) and writers. According to Le@rning Federation personnel this was done to ensure a consistent "style" to all learning objects in recognition of the difficulty that development companies experienced in finding such expertise for short periods of time and of the central importance of these tasks to quality instructional design. From interviews with senior staff, we learned that the decision to bring expertise in-house had resulted in fewer revisions and increased output.

Another development since the last review has been the work undertaken by The Le@rning Federation to assist private sector developers in building internal quality assurance processes. While capacity building will be examined in the following section, it is important to recognize the link between instructional design, quality assurance and the distribution of responsibilities throughout the design to publish cycle.

6.3 Instructional Design as Capacity Building

A 100% focus on instructional design is not a single activity but rather a set of inter-related activities, practices and processes employed through the "design-publish" phases of learning object development. It includes not only The Le@rning Federation staff but all those associated with the project.

To successfully apply quality assurance processes involves not only the development of standards but also the capacity to employ them. In this area The Le@rning Federation has been highly successful in building capacity across the system. However, in doing so, they have assumed a "consultative overhead" to Le@rning Federation operations.

As noted earlier, The Le@rning Federation is breaking new ground with few if any precedents. The nature of its activities, which can be defined as "original and innovative," require The Le@rning Federation to work collaboratively with an extensive group of partners. As well this ensures that learning objects can be used in local settings but also to capture knowledge from across Australia and New Zealand. Education ministries from nine jurisdictions, the Australian government, the Government of New Zealand, the private sector, cultural institutions, museums, local schools, curricular experts, project officers, and teachers are but a short list of those with whom The Learning Federation has worked in recent years. In doing so the Learning Federation has built the capacity of these stakeholders to address in some way instructional design.

It is clear that the efforts necessary to build a coherent and collective understanding among such diverse groups is a capacity building activity. While it results in additional costs to The Learning Federation and local jurisdictions, and greatly increases the time required to move from "design to publish", the result is a growing awareness of the importance of instructional design to the final "product" and therefore how best to use quality designed learning objects with students and teachers. Without an effort to build the capacity to understand the concept of learning objects, it is entirely possible that the content developed would be of the highest quality but little understood and therefore little used in classrooms. Additionally, without an emphasis on instructional design as capacity building, the competitive benefits accruing to the private sector in competing for national or international projects could not occur. In large multi-sectored or multi-jurisdictional projects, the value-added of shared understanding, new insights or greater capacities developed through involvement are overlooked in final evaluations. In this case, a focus on instructional design as capacity building has produced an education sector ready to use learning objects and a private sector able to deliver high quality learning objects.

6.4 Instructional Design as Primary Research

The emergence of learning objects as a focus of educational interest is relatively recent. The idea that educational content can be broken into discrete units facilitating their repurpose across learning activities, remixing within other learning materials and inclusion into a variety of learning environments for use by a range of learners in age and ability was first suggested by Wiley (2000). This notion was largely based on Wiley's earlier work in software design and object oriented computing where portions of software code (software objects) could be

reused in derivative products. The benefits to software development (reusability, repurpose and reduced cost) were felt to be applicable to educational content.

Unlike the software development industry which emerged following WWII, or private sector organizations which first employed computer technology for quantification purposes (data management) in the 1960s, in many respects the education sector is still taking preliminary steps in using information and communication technologies to enhance learning. While the private sector began incorporating desktop computer technologies into core business practices in the 1980s the education sector is still in the process of adopting technologies into its core operations.

The building of local computer infrastructures has had a critical effect on the ability of The Le@rning Federation to distribute and use digital learning materials (interoperability). As a result, it is crucial that the focus upon instructional design as primary research be strengthened by a continued focus on gathering data about the infrastructures necessary to ensure that maximum benefits are obtained from use of learning objects in the classroom. Projects such as The Le@rning Federation are providing important connections between past and future practices in infrastructure, digital content and teaching practices.

7. Learning Objects Review

In this second phase review of The Le@rning Federation content, 14 learning objects were reviewed from six curricular areas. As well six learning assets were also reviewed. This review attempted to assess the extent which The Le@rning Federation learning objects met their own standards but also to what extent the learning objects had become more sophisticated and had incorporated recommendations from our Phase One Review. In short three questions directed our review of the learning objects.
- *To what extent do the learning objects meet the standards established by The Le@rning Federation?*
- *To what extent were the recommendations offered in the Phase One Review adopted into the design of the objects?*
- *To what extent do the current learning objects shown new pedagogical design and capabilities (next generation thinking)?*

The assessment of the six learning assets used criteria focused on their perceived usefulness as primary instructional resources for Australian and New Zealand classrooms. Learning assets reviews were based on the following three questions.
- *How useful would assets be to teachers in enhancing classroom instruction?*
- *How might students use these assets to enhance learning in the classroom?*

- *Was the media used appropriate to the asset itself?*
- *To what extent does the availability of learning assets require additional support mechanisms for their effective use?*

In reviewing the current group of learning objects and assets, it was still the view of the researchers that,

> *Attempts to review learning objects are fraught with complexities not found in assessing other non-digital educational content. Learning objects are multifaceted, incorporating curricular content developed to meet state and national curriculum frameworks. Developers and designers face the need to design objects that are small (disaggregated) yet adaptable in design to allow them to be combined or recombined with other objects to create learning sequences (repurposing). However the disaggregated nature of learning objects requires that "content" be as flexible as possible in its design to encourage teachers to utilize objects across a variety of instructional settings. Hence, the task faced by learning object developers is to design learning materials that can stand alone (disaggregated) and be used in a variety of learning environments (repurposed). Therefore, an evaluation process must be sensitive to the overall goals that designers and developers have for such digital assets as well as the constraints upon designs.* (Muirhead & Haughey, 2003, p.18)

The current review is still confounded by the tensions regarding the variation between national and state curricula, emerging technical considerations, local technical and human infrastructures, local and national distribution mechanisms, the ever present disparity in classroom equipment, disparate connectivity across Australia and New Zealand and the subject matter traditions within particular curricular areas.

Current thinking regarding learning objects is still in development with most learning object research and development taking place at the postsecondary level. With few development projects taking place in the K-12 sector, the current set of learning objects for school age children embody current thinking in the area. A further constraint in reviewing these learning objects is their recent availability for preliminary classroom implementation. The necessity to incorporate findings from classrooms trials, and feedback from teachers and students into the development cycle, is a crucial step that is only now being undertaken through the use of Le@rning Federation materials in Australian, New Zealand and British schools.

The current review of learning objects used the Phase One Learning Object Evaluation Instrument (LOEI) which was modified for this phase. Two previously used criteria were removed from the instrument. One was the diverse needs criterion which stated, "The author indicates whether the learning object is accessible for learners with diverse needs". This deletion was made, in part due

to the complexity involved in applying diverse needs standards to learning objects. Second, to undertake a thorough accessibility review of the current learning objects was outside the scope of this current report. Finally, the removal of "accessibility" for students with disabilities" recognizes that The Le@rning Federation is still struggling with how best to address accessibility.

In interviews with The Learning Federation personnel two approaches emerged regarding accessibility. One was to incorporate accessibility features into all learning objects thus in some cases making the learning objects more complex to develop, more costly to create and in limited cases adversely affecting the overall design of the learning object. A second approach being considered was to develop separate purpose-built learning objects for specific learners with special needs. While commonsense dictates that a balanced approach resulting in some accessibility features being included in all learning objects is desirable, designing learning objects for students with specific and diverse learning disabilities remains a challenge for The Le@rning Federation and for educators across the globe as they commit to the widest accessibility possible for all learners.

The second criterion omitted from the LOEI is the item regarding cultural bias. The criterion for this item stated, "Cultural bias is not evident and is appropriate for community and cultural affiliations, including language, dialect, reading and writing". In the Phase One Review the researchers applied this criterion to all learning objects. At that time we wrote,

> The final item in the evaluation instrument is a criterion regarding the extent to which learning objects are "appropriate for community and cultural affiliations, including language, dialect, reading and writing". This can be the most difficult and potentially the most problematical of the criteria to quantify. (p. 32)

In reviewing the current set of 14 learning objects the reviewers again did not find cultural bias. We believe as we stated in the Phase One Report, that The Le@rning Federation continues to be concerned to ensure cultural neutrality. In short we found as we did in Phase One that "care had been taken. In short, none of the objects require any revision in this area". (p. 31) Furthermore in our current review we found that the inclusion of multiethnic characters (*Race Day, Get a Grip*) and greater use of regional accents used in all learning objects demonstrated a significant awareness of cultural inclusiveness.

7.1 Growing Diversity of Learning Objects and Assets

From an initial review of the current set of 14 learning objects a number of initial observations were apparent. Over the past 18 months, the type, size, and instructional design of Le@rning Federation learning objects have expanded. Rather than following a single design philosophy throughout all objects, the increasing diversity of design elements reflects a growing awareness of new

possibilities in learning object design. Within disparate curricular areas there exist a variety of architectures concerning functionality and the treatment of content. This is best observed in comparing the Australian Studies learning objects (*Heroes of the Air* and *Gold Rush 2*) with the Mathematics (*Wishball: Thousandths* and *Whole Numbers*, and Music (*Musical Number Patterns*; *Music Maker*) learning objects. The *Heroes of the Air* learning object incorporated significant third party content resulting in a "narrative" design. The result was a much larger multimedia intensive learning object than had been previously developed. In the *Wishball* series the learning objects were smaller and incorporated a learning design best described as "explore and practice" where external third party content was not used and little multimedia audio or video (except animation) was employed. The two approaches highlighted both diversity of design approaches but also the use of specific architectures or models for specific curricular areas. This use of different learning approaches with specific curriculums demonstrates how The Le@rning Federation has begun to build new knowledge about approaches to the development of leading edge learning objects. This growing knowledge of the role and benefits of learning assets in online environments suggests that The Le@rning Federation seek out opportunities to exchange learning assets with similar international initiatives to grow the quantity and quality of learning assets available through the teacher exchange.

The variety of learning activities has also expanded within learning objects with many including actions such as repurposing and augmenting story lines in *Heroes of the Air*, or of creating personal/individual reports as shown in *Frog Pond Habitat* or recording experimental results in *Wild Ride* and *Get a Grip*. In *Rap Machine* students are required to write a rap song or poem based on the rhyme and rhythm of the music.

The growing diversity of learning materials was also apparent in the development of a new type of learning resource. Learning or resource assets can be used by students and teachers to augment existing materials or can be used to develop new learning materials where content is required but pedagogy is embedded in the development or creation of new materials. The recognition by The Le@rning Federation that educators often wish to augment their teaching with small readily-available digital materials, either for digital display (PowerPoint or Whiteboard), or for use in the creation of paper-based instructional material demonstrates a growing understanding of how digital materials can be used by students and teachers. The availability of historical materials in a variety of multimedia types, such as the *Announcement of Victory 1945* (Audio), *Banish the Budget Blues* (music), *Helping our Heroes* (photograph), *Vote Yes for Conscription* (QuickTime Movie), the *Birth of White Australia* (photograph) and *Australia's Peril* (poster), illustrates the many types of primary materials to be found in cultural institutions and their rich potential for use in learning settings.

The increasing use of game-like designs is improving with their application in *Gold Rush* and *Bike Race* showing how gaming environments can be used for educational purposes. Educational gaming where the use of the narrative, complex user controlled navigation, the design of immersive environments, and inclusion of success indicators (the amount of gold mined in Gold Rush) is exemplary. As computer games continue to grow in popularity it is likely that learners will expect learning environments to include such activities. Early research suggests that boys in particular can benefit from such gaming environments (Foreman, 2004).

7.2 Improved Navigation within Learning Objects

The 14 learning objects reviewed integrated greater functionality for user control and a wider variety navigation tools in their design than initially observed in the Phase One learning objects. This expanded repertoire of functional capabilities included the additional use of "Help" buttons throughout the object (*Frog Pond* and *Get a Grip*), "Back and Forward" buttons (*Rainforest*) , the use of "demonstrations" to instruct students about how to interact with and make use of the learning object (*Wishball* series). The use of "Loading Buttons" in most learning objects to inform users how long and how fast the object was loading from its source (repository, local server etc.) demonstrated the growing understanding surrounding "interoperability" and the disparate connectivity found within many jurisdictions.

Contextual assistance is found in a number of learning objects (*Rainforest*, *Get a Grip* and *Gold Rush*). Feedback on successful progress through the learning objects has expanded with the use of both audio clues and visual clues (*Buds3*, *Stampede: Balloon Stampede*, and *Wishball* series) to signal to the learner appropriate or inappropriate movements and/or decisions. This use of audio and visual clues is important for both low literacy students who may find text based feedback difficult to comprehend or for visually impaired students who find text-based directions difficult to see.

7.3 Improved Design

The design of the learning objects also shows greater sophistication and variety. Print functions have been added to facilitate students in capturing data generated within the object (*Get a Grip*). In other cases (*Sonic City*) the opportunity to record and capture project materials or to store and reflect on the materials in the learning object (*Frog Pond*, *Heroes of the Air*) is more mature.

Learning object designs that incorporate interdisciplinary experiences across curricular areas is also new. *Sonic City* and *Musical Number Patterns* illustrate this design. In each the pedagogical design and the subject matter content ensures they can be repurposed for use in curricular areas such as Music and Maths, but can also be used in Studies in Australia or Social Studies. This

approach to designing learning objects for interdisciplinary reuse illustrates the potential of learning object design where in addition to small and generic designs enabling reusability, interdisciplinary design enables reuse and repurposing across classroom settings, disciplines and age levels.

Better graphics are also apparent in the latest learning objects. While largely a subjective observation, the rendering of the graphics, the incorporation of different graphic styles, and the use of authentic settings (*Race Day* and *Get a Grip, Sonic City*) provided a more pleasing interface and are likely more motivational for students and teachers.

The inclusion of multiple challenge levels is a new design feature found, for example in *Stampede: Balloon Stampede*. The inclusion of a challenge level is a desirable design feature which serves the dual purpose of providing additional activities while also scaffolding learning within a single object. It also serves the purpose of further reinforcing learning experienced in the initial set of learning activities. As this option only appears in this single learning object, it should hopefully become a new functional instructional design feature that may be incorporated in other learning objects (see Recommendations).

In the Phase One Review, most learning objects were developed for younger students. However, the development of learning objects such as "*Elemental Frog Pond*" which is targeted for senior students suggests that the more advanced the audience and content, the larger some learning objects may become. Within the academic literature most authors suggest that learning objects should be small and focused on smaller portions of domain specific knowledge. It is thought that small learning objects encourage reusability and repurposing by teachers. However, learning objects for senior students with more advanced subject matter which also retain the desired pedagogical features designed into schooling level learning objects, are likely to become more complex and may grow in size and density.

As larger objects generally include more content components and predetermined pedagogies there is an increasing risk that this may reduce the instructional approaches employed by teachers. Consequently it is a matter of balancing competing approaches between larger more comprehensive learning objects which can border on units or modules and smaller learning objects that may not address all aspects of the knowledge or skills desired but result in learning objects that are more easily repurposed and reused. As additional features are added to learning objects, such as Help Buttons, demonstrations, and greater use of multimedia, the overall mass of learning objects may also grow. Without comprehensive field testing to gather data about the optimum size of learning objects, answers will remain illusive. While no universal learning object design has emerged at present, it is heartening to see that The Le@rning Federation has not slavishly adhered to the notion of "small at all costs". Rather The Le@rning Federation is commended for exploring a range of learning objects that

when implemented in schools will better answer questions about optimum design.

7.4 Implementation of Recommendations from the Phase One Review

One objective of this Phase Two project scope was to answer the question
- *Has The Le@rning Federation taken account of feedback provided in Phase One review?*

In Phase One the recommendations included suggestions to ensure that learning objectives were clearly stated in all learning objects, that navigation tools were expanded, that there were increased opportunities for user feedback and new ways for learners to create "artifacts" or records of their involvement with specific learning objects. In each of these areas progress has been made.

In Phase One, it was recommended that clear instructions for users be provided in all learning objects. In most current learning objects (Buds 3 being a particular problem) this recommendation has been implemented, The Science Maths and Literacy learning objects are particularly good in providing clear instructions and clear learning objectives.

Another area of concern in the earlier review was the underdeveloped use of "hints" or feedback to students in many learning objects. This has been addressed with more attention to contextual hints (*Wishball*) or hints as to more appropriate choices to address problems presented in the learning object (*Get a Grip*). In *Gold Rush 2*, the character not only offers helpful hints to address shortcomings in planning to mine for gold but also identifies the deficiencies and directs the user back to Ballarat for additional supplies.

A further recommendation in Phase One was to incorporate "loading bars" in all learning objects. This was proposed to provide feedback to users in low bandwidth locations. Again this recommendation has been included in most learning objects and was of particular importance to the reviewers accessing the learning objects from Canada.

In the Phase One review, the researchers observed that that learning objects are of greater value if they provided learners with educational experiences not readily available in school settings. The current set of learning objects illustrate the possibilities with learning objects, such as *Frog Pond*, *Heroes of the Air*, *Race Day*, *Get a Grip*, *Rainforest,* and most predominantly *Sonic City,* providing students with simulated experiences, or tasks (*Sonic City*), not easily reproduced in classroom environments.

Finally, one recommendation from Phase One has not been acted upon. In Phase One, the reviewers recommended that an online teachers exchange be developed to encourage the sharing of best practices, classroom instructional

material, units, or modules which employed learning objects. While the reviewers acknowledge that this undertaking falls outside of the initial scope for The Le@rning Federation, it is still our view that as more educators gain access to learning objects and begin to use these high quality assets in classrooms, the importance of the online site will increase. It is conceivable that as The Le@rning Federation moves into a second phase concentrating on the implementation of the learning objects within schools, that a teacher exchange mechanism which can build a national community of practice will be critical to successfully implementing learning objects in classrooms across Australia and New Zealand.

8. Recommendations Arising From the Phase Two Review of Learning Objects and Assets

In reviewing the current learning objects we have again provided a number of recommendations. These should not be seen as arising from poorly designed learning objects; rather they are intended to be constructive suggestions for the ongoing improvement of learning object designs. We recognize that significant progress has been made since September 2003. To build on this progress and ensure the enhancement and quality fit of future instructional designs, the utility of these learning objects and assets in school settings must be measured.

- Comprehensive Help features while improved still require attention in most learning objects. While many objects now include some form of help feature they can still be improved with extra information about how to use the learning object and how to navigate through the learning object. The object most in need of this feature is *Buds 3* which has no help features or contextual assistance.

- For learning objects to be used independently by learners they require a statement of learning purpose when users first interact with the object. The challenge is to state the learning objectives without defining the learning object so narrowly as to make its repurposing across the curriculum or between learners difficult. However, while difficult, to omit this feature from the design of the learning objects is to risk students making incorrect assumptions about the knowledge schema for particular curricular areas or drawing wrong conclusions about how the object relates to other learning activities or materials.

- Navigation has improved from the initial set of learning objects reviewed in 2002. The goal of navigation for all learning objects should be to maximize learner control. However, while a laudable goal, designers must balance the necessity of linear progression through a learning object with a true hyperlinked structure which does not follow a set path. This lack of linearity may be detrimental where skills or knowledge is hierarchical. After reviewing the larger objects a number of innovative features have been observed and

they should be incorporated into other objects. For example, in Rain Forest, the option to repeat a video portion or audio sections was a positive feature. For example, in the Science series the option to move back and forward was also noted as a positive navigation feature. In the *Wishball* series, the inclusion of a back and/or undo button would allow students to make more complex choices.

- As some learning objects become larger, it is inevitable that many students will find themselves unable to complete all learning activities in a single sitting. Therefore, it is crucial that some form of "bookmarking" function be built into the learning object to allow students to record not only their progress within the learning object but also any notes, activities or other work undertaken or recorded in the learning object. While this will undoubtedly present technical difficulties at the local level where learning objects are distributed on CDROM or in schools or classrooms which "lockdown" computers the strong benefits accruing to learners who use larger learning objects makes this an essential feature.

- In Phase One, the reviewers recommended that print features be improved and be incorporated where such features added educational value. It is important to note that this recommendation has been followed and improved upon. For example, in *Heroes of the Air*, the print feature allows students to save their stories by printing screen shots of their revised story lines; while in *Frog Pond*, students can record ideas notes and results of experiments in an online note book which can be printed for later use. The capability to produce an "artifact" is important as it not only allows learners to record their progress but also gives them a record (artifact) of their participation in a learning activity. The importance of using data generated in a learning object for further use is recommended. To do so requires some form of "saving" function outside the learning object itself. It is also recommended that this capability be expanded to include saving notes or the results of experiments to the local hard drive (client side). This would allow students to incorporate data from the *Get a Grip* into a spreadsheet for further manipulation or to copy notes or observations from *Rain Forest* into more comprehensive projects. In addition, it is advisable where third party rights have been negotiated for materials included in learning objects such as in *Gold Rush 2* or soundscapes in *Sonic City*, that they be saved outside the learning object for additional use in educational activities. An "export" function for original content would complement designs already developed for learning assets.

- Not all students have the same knowledge base of computer use or possess preexisting skills in using the basic tools for controlling computers (the mouse, arrow keys, keyboard etc.). Students from disadvantaged backgrounds may not have the same skills as more advantaged students. Consequently rather than providing extensive text based help files for navigating a learning object, the use of demonstrations such as found in the *Wishball* series is

recommended. Additionally, the use of audio or video instruction such as in *Rainforest* or in the *Race Day* and *Gold Rush 2* show significant promise for specific student cohorts.

- Derivative learning objects or objects sharing similar coding, including look and feel, may expand the number of learning objects available but at a much lower cost. In Phase One, the *Array* series demonstrated this. In this review the *Wishball* series once again demonstrates how small coding changes (whole numbers to decimals) can add significant value and ladder student understanding and skill acquisition through derivative designs. The benefits are many including the similar look, feel and navigation for students who can easily move from one object to the next. The clustering of learning object themes in a similar design is an additional benefit. Moreover, derivative learning objects can include thematic approaches, such as the bicycle theme (*Get a Grip* and *Race Day*).

- The review of learning objects from the curricular area, Languages Other Than English (LOTE), illustrated the importance of intuitive navigation and "demonstration" to their successful implementation. Not all learners will have acquired sufficient second language skills to fully understand the learning objects where directions are provided in the second language. In contrast to *Stampede, Balloon Stampede*, the *Lost Bike* learning object did not have sufficient explanation and did not include a demonstration to assist learners in successfully using this object. While teacher intervention will likely mitigate confusion around learner use, it is recommended that additional design features be developed to support learners using second language learning objects to greater independence.

- Where game-like learning object designs are employed, it is recommended that consideration be given to building multiple levels or additional challenge activities into their design. This would mimic traditional gaming environments and provide further reinforcement for skills and activities.

- Learning assets are a significant addition to the learning object landscape available from The Le@rning Federation. The ability of teachers and students to access primary historical or cultural materials holds as much promise to enhance learning as learning objects do. However, there may be some concern that the original content will be available without a relevant cultural or historical context or will lack direct connections to museums or cultural institutions housing the original work. To address these concerns it is recommended that, where appropriate, metadata in the Learning Exchange provide links to the cultural and historical institutions from which the original content was obtained to assist students and teachers to access more information about the larger context of the assets.

- As greater numbers of learning objects are developed some consideration must be given to the use of similar interfaces to assist students in using multiple objects. However this must be balanced by the need at this stage to experiment and have the freedom to establish best practices in this area. Rather than creating a mono-design, The Le@rning Federation should begin gathering relevant data about design features to develop best practice standards for future learning objects.

9. Suggestions Directions and Future Work

- As learning objects are developed to address more complex curricular areas (*Frog Pond*, *Get a Grip*, *Race Day*, or *Gold Rush*) the importance of teacher support grows. Teachers require guidance to link learning objects to curricular statements and other resources available to them and their students. As stated in our Phase One recommendations, it is recommended that an online teacher exchange be developed to facilitate the sharing of best practices surrounding how educators have used specific learning objects. When developed it is further recommended that that some form of initial peer review be developed to ensure that the materials meet a minimum professional standard. Unlike the rigor of The Le@rning Federation quality assurance process, this repository should be administered by educators in the field who can assess the usefulness of materials available in the teacher exchange.

- Learning objects such as *Sonic City*, *Heroes of the Air*, or *Rap Machine* offer new opportunities for students to create new "artifacts" (rap songs, new multimedia presentations, original PowerPoint presentations or new soundscapes). As more learning objects are developed, it is likely that such opportunities will grow. Consequently, it is recommended that some form of student website or repository be created to showcase exemplary student work based on the use of learning objects. Such a site would complement the proposed teacher exchange site and could be a powerful vehicle to assist teachers in understanding the power of learning objects to motivate students, and augment classroom instruction.

- The adoption of learning objects by educators involves openness by teachers to changing professional practices through the use of information and communications technologies in the classroom. We recommend that The Le@rning Federation give thought to creating an award for innovative use of learning objects. This award would recognize the pioneering efforts of educators from across Australia and New Zealand and publicly recognize the efforts of teachers.

- Similarly, as greater numbers of students begin to develop projects based on their initial use of a Le@rning Federation learning object, that some national award also be created. Again like the proposed teacher award, this

recognition would support those making exemplary use of learning objects and would generate much needed awareness of the power of learning objects to enhance learning opportunities.

- We reiterate our earlier recommendation from the Phase One Review and recommend the inclusion of linkages to external resources within learning objects. The Le@rning Federation should explore the benefits of linking learning objects with other available quality online resources. These links will be critical as additional learning assets are placed in The Le@rning Federation Exchange where "contextual" references will be most needed.

- The inclusion of learning assets in The Le@rning Federation exchange suggests there is value in adding additional learning materials from the current initiative into the exchange. We encourage The Le@rning Federation to partner with similar projects to exchange materials thereby adding to the number of learning objects available to teachers.

- We also encourage The Le@rning Federation to explore new ways of involving the teaching community in using the learning object "templates" to create derivative objects for sharing through the proposed teacher exchange.

- We encourage The Le@rning Federation to explore developing virtual learning environment (VLE) for use by educators. Such a VLE would provide not only an environment for interaction but also be a powerful medium for teachers to create and "publish" learning materials for new learning activities.

References

Arthur, L., Beecher, B., & Downes, T. (2001). Effective learning environments for young children using digital resources: An Australian perspective. *Information Technology in Childhood Education Annual 2001*(1), 139-153.

Ashton, H., Beevers, C.E., & Bull, J. (2004). Piloting e-assessment in Scottish schools—building on past experience. *International Journal on E-Learning, 3*(2), 74-84.

Astleitner, H., & Wiesner, C. (2004). An integrated model of multimedia learning and motivation. *Journal of Educational Multimedia and Hypermedia, 13 (1*), 3-20.

Becta. (2004). *What the research says about ICT and continuing professional development (CPD) for teachers.* Retrieved January 09, 2005, from http://www/becta/org.uk/research/research.cfm?section=1&id=522

Becta. (2004a). What the research says about virtual learning environments in teaching and learning. Retrieved January 09, 2005, from http://www/becta/org.uk/research/research.cfm?section=1&id=545

Berg, G. (2000). Cognitive development through narrative: Computer interface design for educational purposes. *Journal of Educational Multimedia and Hypermedia, 9* (1), 3-17.

Bosco, J. (2003). Towards a balanced appraisal of educational technology in US schools and a recognition of seven leadership challenges. Paper presented at the Consortium for Schools Networking Conference, Washington, DC, February and 3rd Annual Becta Research Conference, London, June. Retrieved from http://www.becta.org.uk/research/research.cfm?section=1&id=2854

Boyle, T. (2003). Design principles for authoring dynamic, reusable learning objects. *Australian Journal of Educational Technology, 19*(1), 46-58. Retrieved December 05, 2004 from http://www.ascilite.org.au/ajet/ajet19/boyle.html

Bransford, J.D., Brown, A.L., & Cocking, R.R. (1999). *How people learn: Brain, mind, experience and school.* Washington, DC: National Academy Press.

Brown, A., Miller, D., & Robinson, L. (2003). Teacher-directed software design: The development of learning objects for students with special needs in the

elementary classroom. *Information Technology in Childhood Educational Annual 2003*, 173-186.

Clyde, L. (2004). Digital learning objects. *Teacher Librarian, 31* (4): 55-57.

Collis, B., & Strijker, A. (2003). Reusable learning objects in context. *International Journal on E-Learning*, (October-December): 5-16.

Cox, M., Abbot, C., Webb, M., Blakeley, B., Beauchamp, T., & Rhodes, V. (2004). ICT and attainment. A review of research literature. UK: Becta. Retrieved January 09, 2005, from http://www.becta.org.uk/research/research.cfm?section=1&id=3119

Cox, M., Webb, M., Abbot, C., Blakeley, B., Beauchamp, T., & Rhodes, V. (2004). An investigation of the research evidence relating to ICT pedagogy. Coventry, UK: Becta.

Deubel, P. (2003).An investigation of behaviorist and cognitive approaches to instructional media design. *Journal of Educational Multimedia and Hypermedia, 12*(1), 63-90.

Duncan, C. (2003). Digital repositories: e-learning for everyone. Presentation at eLearning International, Edinburgh, 9-12 February. Retrieved from http://www.intrallect.com/

Dunning, Rogers, Magjuka, Waite, Kropp, Gantz, Kaur, Vidali, Hunt, & Vandermolen, (2004). Technology is too important to leave to technologists. *JALN, 8*(3), 1121.

Foreman, J. (2004). Game-based learning: How to delight and instruct in the 21st century. *Educause Review*, *19*, 3, 50-66.

Gibson, S., & Oberg, D. (2004). Visions and realities of Internet use in schools: Canadian perspectives, *British Journal of Educational Technology, 35*(5), 569-586.

Harper, B., Squires, D., & McDougall, A. (2000). Constructivist simulations: A new design paradigm. *Journal of Educational Multimedia and Hypermedia, 9* (2), 115-130.

Hedberg, J. (2004). Designing multimedia: seven discourses. *Cambridge Journal of Education, 34*(2), 241-256.

Hedberg, J. & Sims, R. (2001). Speculations on design team interactions, *Journal of Interactive Learning Resources, 12*(2/3), 189-214.

Hunt, M., Parsons, D., & Fleming, A. (2003). A review of the research literature on the use of managed learning environments and virtual learning environments in education, and a consideration of the implications for schools in the United Kingdom. UK: Becta. Retrieved January 09, 2005, from http://www/becta/org.uk/research/research.cfm?section=1&id=545

InterActive Education. (2002). About the Project website. Retrieved January 08, 2005, from http://www.interactiveeducation.ac.uk/about.htm

Johnson, L. F. (2003). Elusive vision: Challenges impeding the learning object economy. San Francisco: Macromedia Inc. Retrieved December 04, 2004, from http://www.nmc.org/pdf/Elusive_Vision.pdf

Joint Interoperability Standards Committee (JISC), (2000). Managed learning environments: A workshop run by JICS Assist, 29 February and 7 March 2000. Final Report. JISC. Retrieved December 05, 2004, from http://www.jisc.ac.uk/index.cfm?name=event_report_mle

Jonassen, D., & Churchill, D. (2004). Is there a learning orientation in learning objects? *International Journal of E-Learning*, (April-June): 32-41.

Jones, A. (2004). A review of the research literature on barriers to the uptake of ICT by teachers (29pp). UK: Becta. Retrieved December 05, 2004, from http://www.becta.org.uk/research/research.cfm?section=1&id=3310

Jones, R. (2004). Designing adaptable learning resources with learning object patterns. *Journal of Digital Information, 6*(1), Article 305, 2004-12-10. Retrieved December 31, 2004, from http://jodi.ecs.soton.ac.uk/Articles/v06/i01/Jones/?printable=1

Kenworthy, N. (1993). When Johnny can't read: Multimedia design strategies to accommodate poor readers. *Journal of Instructional Delivery Systems, 7*(1), 27-30.

Kovalik, C. (2003). Reflections on a technology integration project. *Journal of Technology and Teacher Education, 11*(1), 73-90.

Kraan, W. (2005). Intralibrary slots into Australian interoperability research project. Centre for educational technology interoperability standards (CETIS). Retrieved January 17, 2005, from http://www.cetis.ac.uk/content2/20040108180539

Lake, D., Phillips, R. Lowe, K. Cummings, R., Schibeci, R., & Miller E. (2004). Field review of the Schools Online Curriculum Content Initiative. Report of Stage 1. Unpublished document. Melbourne, Victoria: The Le@rning Federation.

Lamb, B. (2004). Sharing educational resources: Creating copyright policy that works for creators and users. UBC's E-Strategy, (Sept., 29). Retrieved November 20, 2004 from http://www.e-strategy.ubc.ca/news/update0409/040929-copyright.html

Laurillard, D. (1997). *Multimedia and the learner's experience of narrative*. Milton Keynes, UK: Meno publications, British Open University.

Laurillard, D. (2002). *Rethinking university teaching: A conversational framework for the effective use of learning technologies*. London, UK: RoutledgeFalmer.

Long, P. D. (2004). Learning object repositories, digital repositories, and the reusable life of content. *Campus Technology*. Retrieved December 04, 2004 from http://www.campus-technology.com/article.asp?id=9258

Luckin, R. (2001). Designing children's software to ensure productive interactivity through collaboration in the zone of proximal development (ZPD). *Information Technology in Childhood Education Annual 2001*(1), 57-85.

McCluskey, A., Hoffer, M., & Wood, D. (2004). School: a sustainable learning organization, perceptions and forces at play in institutional change in education in the light of the uptake of ICT. ERNIST Organizational change project. Retrieved December 04, 2004, from http://www.eun.org/eun.org2/eun/en/Insight_Research&Development/content.cfm?ov=33813&lang=en

McCormick, R. (2003).Keeping the pedagogy out of learning objects. Paper presented in the *Designing Virtual Learning Material* Symposium, at the EARLI 10th Biennial Conference *Improving Learning, Fostering the Will to Learn*, 26-30 September.

McCormick, R. (2004). ICT and student assessment. *The Curriculum Journal, 15*(2), 115-137. Retrieved December 04, 2004, from http://www.eun.org/eun.org2/eun/en/Insight_Research&Development/content.cfm?ov=33827&lang=en

McCormick, R., Scrimshaw, P., Li, N., & Clifford, C. (2004). CELEBRATE Evaluation report (version 2). Retrieved December 05, 2004, from http://www.eun.org/eun.org2/eun/Include_to_content/celebrate/file/Deliverable7_2EvaluationReport02Dec04.pdf

McGreal, R. (2004). Learning objects: A practical definition. *International Journal of Instructional Technology and Distance Learning, 1 (9).* Retrieved December 04, 2004, from //itdl.org/Journal/Sept_04/article02.htm

McLaren, I. (2004). New trends in web-based learning: objects, repositories and learner engagement. *European Journal of Engineering Education, 29* (1): 65-71.

Muirhead, W. & Haughey, M. (2003). An assessment of the learning objects, models and frameworks developed by the Learning Federation schools online curriculum content initiative Australia. Phase one. Retrieved January 15, 2005, from www.

Nichani, M. (2001). LCMS = LMS + CMS [RLOs]. Elearning post (May 02). Retrieved January 06, 2005, from http://www/elearningpost.com/features/archives/))1)22.asp

Parrish, P. (2004). The trouble with learning objects. *ETR&D, 52*(1), 49-67.

Passey, D., Rogers, C., Machell, J., & McHugh, G. (2004). The motivational effect of ICT on pupils. UK: Becta. Retrieved January 08, 2005, from http://www.becta.org.uk/research/research.cfm?section=3&id=558

Pedersen, S., & Williams, D. (2004). A comparison of assessment practices and their effects on learning and motivation in a student-centred learning environment. *Journal of Educational Multimedia and Hypermedia, 13*(3), 283-306.

Phelps, R., Graham, A., & Kerr, B. (2004). Teachers and ICT: Exploring a metacognitive approach to professional development. *Australasian Journal of Educational Technology, 20*(1), 49-68.

Pisha, B. & Coyne, P. (2001). Smart from the start: The promise of universal design for learning. *Remedial and Special Education, 22*(4), 197-203.

Polsani, P. R. (2003). Use and abuse of learning objects. *Journal of Digital Information, 3* (4), Article 164, 2003-02-19. Retrieved December 05, 2004 from http://jodi.ecs.soton.ac.uk/Articles/v03/i04/Polsani/?printable=1

Poupa, C., & Forte, E. (2003). Collaborative teaching with learning objects in an international, non-profit context. The example of the Ariadne community. *Educational Media International, 40* (3/4), 239-248.

Richards, G., McGreal, R., Hatala, M., & Friesen, N. (2002). The evolution of learning repository technologies: Portals for on-line objects for learning. *Journal of Distance Education, 17*(3): 67-79. Retrieved December 15, 2004 from www.cade-aced.ca

Sandholtz, J. H. (2001). Learning to teach with technology: a comparison of teacher development programs. *Journal of Technology and Teacher Education, 9* (3), 349-374.

Scrimshaw, P. (2004). Enabling teachers to make successful use of ICT (45pp). Coventry, UK: Becta. Retrieved January 15, 2005, from http://www.becta.org.uk/research/research.cfm?section=1&id=3310

Selinger, M. (1998). A review of the literature relating to preparation for and use of IT in schools. IN S. Harris (Ed.), *INSET for IT*, p. 14. Slough, Berks: NFER.

Smith, R. S. (2004). *Guidelines for authors of learning objects*. NMC: Austin, TX: The New Media Consortium. Retrieved December 04, 2004, from //www.nmc.org/guidelines/

The Le@rning Federation. (2004). Exploring learning objects with teachers of indigenous students. Snapshot 2. September. Unpublished document. Melbourne, Victoria: The Le@rning Federation.

The Le@rning Federation. (2004). Exploring learning objects. Snapshot 1. August. Unpublished document. Melbourne, Victoria: The Le@rning Federation.

Thomas, G., & Horne, M. (2004). Using ICT to share the tools of the teaching trade. A report on open source teaching. Coventry, UK: Becta. Retrieved January 08, 2005, from www.becta.org.uk/page_documents/research/open_source_teaching.pdf

Tomlinson, M. (2002). Inquiry into A-level standards (Final report). Coventry, UK: Becta. Retrieved July 12, 2003, from http://buildingthegrid.becta.org.uk/index.php?locId=122

Underwood, J., Ault, A., Baynard, P., Dillon, G., Durbin, C., Golland, D., Hayes, M., Selwood, I., Somekh, B., Twining, P., & Woodrow, D. (2004). Connecting with broadband: Evidence from the field. Coventry, UK: Becta. Retrieved January 09, 2005, from http://www.becta.org.uk/research/research.cfm?section=1&id=3304

U.S. Department of Education. (2005). U>S> Department of Education releases national education technology plan. Retrieved January 14, 2005, from http://www.ed.gov/news/pressreleases/2005/01/01072005.html

Voithofer, R. (2003). Teaching computers to tell stories: Using critical narrative theory to frame design and evaluation strategies for online educational

experiences. *Journal of Educational Multimedia and Hypermedia, 13(1*), 47-72.

Wiley, D. (2000). Connecting learning objects to instructional design theory: a definition, a metaphor, and a taxonomy. In D.A. Wiley (Ed.), *The instructional use of learning objects Online version* (Chapter 1). Retrieved September 12, 2003 from http://reusability.org/read/chapters/wiley.doc

Learning Object Review

Title: Rainforest tracks, maps and signs

Volunteer to help get a rainforest ready for the next tourist season. Read a brochure that includes maps showing climate patterns. Choose clothing for your trip from a catalogue. Book a flight to south-east Australia using 24-hour time. Explore the layers of a rainforest. Choose symbols to stand for rainforest features. Use grid references and compass points to find locations on a map. Mark the route for a new walking track. As you go, look up the meaning of tricky words

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	4
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	2-3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3 see comments
10. Help and documentation files are provided for	2 see comments

students and teachers including contextual assistance (Accessibility).	
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

This learning object illustrates many of the best practices found in learning object design. As a learning object designed for use with low literacy students the inclusion of multimedia elements such as the audio and video clips to introduce activities and providing instructions about navigating the learning object are very effective. The use of multimedia components to reinforce text instructions about learning activities is reinforced by the inclusion of a replay button. This replay feature is especially important for low literacy students who may try and decode text using the audio clips as clues. Testing for reading comprehension is reinforced by such activities as questioning or by simple tasks such as dialing the mobile phone.

Where new words are introduced the use of hyperlinks to word definitions and oral pronunciation is well executed. However, this feature could be expanded to include additional words or all words in some sections of the learning object.

Navigation is clear with back and forward buttons. Even so, the back button does not take the learner one step but returns the learners to the beginning of the task. This becomes problematic when students wish to move one step back between tasks (reading the brochure, packing, or booking a flight). Another recommendation is to incorporate some means by which students can bookmark their progress within the learning object without loosing their previous work. Without this function, students are required to begin at the beginning of the learning object rather than return to where they last finished. It is likely that as learning objects become larger they will require students to use learning objects over many sessions which will result in the need for a "bookmarking" feature.

Overall, instructions are clear and the hints and tips/feedback throughout the LO are well developed, with activities related to packing for the trip to the rainforest particularly well executed. Finally, it is important to have contextual help available throughout all learning objects of this size and complexity.

Learning Object Review

Title: Sonic space: city

Use sounds from the city to create your own soundscape. Listen to some sounds and think about where they come from. Place sounds from a city picture into a sound space. Combine and arrange these sounds to make a soundscape. Record and listen to the soundscape. Think about any changes you'd like to make then remix or create a new soundscape

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3 Needs additional explanation within the object regarding its links to curriculum.
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	4
4. There are clear instructions for using the learning object (Usability).	3 requires a help button
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	4
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	4

10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	1
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	This object can be used with minimal teacher intervention

Comments

This learning object highlights how multimedia technology, computer technology and creative instructional design may combine to create a learning experience not readily replicated in the classroom. Sonic City is one of a set of learning objects that demonstrate the new opportunities for learning when learning objects are well designed.

The central premise of capturing everyday sounds from a city environment and later remixing these in combination with a visual tool set, marks this as a learning object "exemplar". It should be shared with the development community to show what is possible when an interdisciplinary focus is used to design unique learning experiences.

This learning object shows a new interdisciplinary focus to thinking about sound, music, social studies and potentially urban planning. However, the learning object could be improved by the use of a load button when first launched by a learner. The object lacks a help button. It is sometimes difficult to identify the hotspots on the screen to capture sounds from on the urban landscape. The visual clues for scrolling across the landscape could be more prominent with other visual clues used to signal the visual plane extends beyond the initial screen.

One interesting feature is the inclusion of a notebook for writing about the experience of using this learning object. The print feature will allow students to create an "artifact" of their experience. While it is commendable to have the opportunity to record thoughts and to reflect on the guided questions for later reflection, it is recommended that given the opportunity to further enhance and add to the soundscape that a "save" feature be built into the learning object to allow students to further add local sounds to their initial sound landscape. Moreover, the ability to play the soundscape created within the learning object makes this feature crucial.

Learning Object Review

Title: Lost bike: build your own bike [Indonesian]

Match pictures of bikes with words describing size, color and accessories. Choose words to complete a description of a bike you would like to build. Use pictures and feedback to find where bikes are hidden in a village.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	Impossible to determine
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	0
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	0
4. There are clear instructions for using the learning object (Usability).	0
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	0-1
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	0-1
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	0-1
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	0
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	0-1
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	0
11. Design of visual and auditory information enhances learning and mental processes	0-1

Assessment of the Learning Objects, Models and Frameworks

(Accessibility).	
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Yes at this stage of development

Comments

The design of this learning object appears confusing. It is unclear what the objective of the learning object is and how the learner is to navigate through the object. The learning object lacks a clear introduction or statement about learning objectives. The LO has no "help" feature, no demonstration function to help users understand how to move through the learning object.

Other design elements such as having the time recorder begin as soon as the learner launches the learning object contributes to frustration and confusion. Moreover, the lack of a "back" or "forward" or stop button leaves learners unable to reflect or integrate learning contained within the learning object.

Learning Object Review

Title: Stampede: balloon stampede [Japanese]

Look at the structure of Japanese characters appearing on a series of balloons. Classify the structure of each character. Stamp the characters according to their structures. Correct answers will pop the balloons. Note that there are about 400 components (basic characters) in Japanese writing. These components act as building blocks, which can be joined in different ways to form new characters. A combination of characters is called a structure. There are ten main structures as well as some exceptions. Learn the first three structures. Build your knowledge of character components and structures by checking meanings and spoken examples. Notice there are some exceptions to the general patterns when compounding characters. Increase the challenge by adjusting speed.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	3
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	3-4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	3-4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3-4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	2-3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used	3

(Learner Focus-design).	
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3-4
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	2
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	3
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently by a learner but does require some initial instruction

Comments

This object demonstrates effective navigation and sets learning objectives at the onset of the learning object. Audio feedback reinforces navigation and successful task completion. The graphics are clear and appealing to students.

The inclusion of a "challenge level" in this learning object design is a feature that is not found in other learning objects reviewed. Its inclusion in this learning object is a positive feature and one that, where appropriate, could be used in other learning objects. One area that does require revision is the lack of an explanation regarding the use of arrow keys to change the path of the symbols in the second level tasks. The use of arrow keys to direct the washing from the clothes line into the wash baskets is not explained. Only after trial and error did this become apparent. The lack of clear directions was compounded by the lack of contextual help features in the learning object.

Appendix 1
Learning Object Review

Title: Buds 3

Play the role of a farmer trying to win an award for business innovation. Start out by farming fresh flowers and selling them. Then find new opportunities by approaching businesses in the street. Decide which equipment to buy in order to take advantage of market opportunities.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	0 unclear
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	0
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	0
4. There are clear instructions for using the learning object (Usability).	0 non-existent
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	0
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	0
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	0
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	0
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	0
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	0

11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	0
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	yes

Comments

The metadata for this learning object describes its learning objectives introducing students to concepts regarding risk management, ideas about supply and demand, the role of the marketplace, and resource allocation in the production cycle for students from ages 10-14. Many of these concepts are "conceptually difficult" and are developmentally complex for this age group to understand. Therefore, this learning object may suffer from trying to address too much subject matter within single learning object. However, it cannot excuse the instructional design deficiencies of this object.

The learning object requires an initial introduction regarding the learning objectives and purpose. It is unclear from the initial splash page how learners can successfully navigate within the learning object. The icons for the $50 flower appear without an explanation. The learning object contains no instructions regarding how to interact. It is unclear except by trial and error that the garden can be watered which cause additional flowers to grow but at a cost. The interaction between the cost of water and the currency at the top of the page is not intuitive.

It is only by intuition that a learner will guess how to move throughout Main Street. The lack of a help feature or contextual instructions results in pages appearing with no explanation such as clicking on the flower on the splash screen and having a second page appearing with a red "X". Moreover, it was only by randomly clicking across the screen that the researchers discovered the use of the press caused additional cards to be printed and the currency notation changing at the top of the screen. The connection between these two actions was not explained.

The remaining design elements within the learning object are equally confusing. It is unclear why the farmer can successfully sell cards to some merchants and yet not to others! Except for sound effects, there is no feedback to help orient students to concepts being presented. Confusing visual clues such as the halo are not given explanation. This LO requires significant redesign for it to be successfully used in a learning setting.

Appendix 1

Learning Object Review

Title: Rap Machine

Mix your own rap music. Start with some model lyrics and beats. Change each line to make a new rap about space travel. View words in either rap or standard English. Choose a beat. Get a rapper to perform your song. This is the first in a series of three activities, which progressively increase in difficulty.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	4
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	2 see comments
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	3
11. Design of visual and auditory information	4

enhances learning and mental processes (Accessibility).	
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

Reviewing learning objects is both an objective activity but often it also includes subjective impressions from personal experience. When first reviewed, this learning object seemed to lack much value except its description of Rap music. However, upon reflecting upon the instructional context in which this learning object would be used it became clear that that the learning object could be used in many creative ways. This revision illustrates the necessity to think beyond a "decontextualized" learning context but to engage in evaluate learning objects with a though to their use in classroom environments.

Preliminary research gathered by The Learning Federation suggests that this learning object is both popular with students and teachers. Reports from field testing suggests it has strong motivational power with students resulting in their writing and recording personal rap songs based on their use of this learning object.

This LO has a number of design elements that are commendable. They include,

- The comparison, illustration and editing functions between Standard English and non-standard English.
- A real-time demonstration feature allowing students to see the power of language reflected in different meanings resulting from small changes in word use. This is clearly a significant feature for low literacy students.
- Inclusion of a short history of Rap music is important to set a context to the music. The addition of links or suggestions directing students to additional resources about Rap music should be considered in the next version of this learning object.

Learning Object Review

Title: Musical number patterns: music maker

Make some music by building up rhythms for four instruments. Choose a starting point on a number line and build a counting rule. Count in lots between 2 and 10 until you reach 36. Add your number several times on the number line to make a pattern. For example, set up a sound pattern where a trumpet waits on the first note, and then sounds on every third note. Add a second or third number pattern for other musical instruments. Then play all of the sound patterns together to hear your music.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	3
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	3
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	4
10. Help and documentation files are provided for	4

students and teachers including contextual assistance (Accessibility).	
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

This learning object includes an element not found in other reviewed objects. The inclusion of a simulation or demonstration at the onset of opening this object is a highly effective means to providing assistance and directions to learners.

Inclusion of intuitive visual clues throughout the learning object benefits students with low literacy skills. It also corresponds to how many current users (students) learn computer skills—observation based on trial and error.

Another unique aspect of this particular learning object is its interdisciplinary potential which would allow its reuse in curricular areas such as music, and the study of mathematics thus demonstrating the goal of reusability and repurposing.

Learning Object Review

Title: Wishball: thousandths

Test your understanding of decimal place value. Start with a number such as 3.569 that includes thousandths. Spin a random digit, and then choose its decimal place value. Decide whether to add or subtract the random digit from your target number. The starting number will be adjusted by the amount you choose. Work towards a given target number such as 7.832. You can use a 'Wishball' to help you reach the target number. Try to achieve the target with as few additions or subtractions as possible.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3
7. Pre-requisite knowledge/skills, if needed, are identified and make clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3
10. Help and documentation files are provided for	3

students and teachers including contextual assistance (Accessibility).	
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

Similar to Wishball whole numbers this learning object showcases the potential inherent in reusing portions of design code, interface design including its underlying software coding for creating derivative learning objects. All of the positive learning designs found in the Wishball whole numbers are also found here.

Learning Object Review

Title: Wishball: whole numbers

Test your understanding of decimal place value. Start with a whole number such as 1374 that includes four digits. Spin a random digit, and then choose its decimal place value. Decide whether to add or subtract the random digit from your target number. The starting number will be adjusted by the amount you choose. Work towards a given target number such as 3278. You can use a 'Wishball' to help you reach the target number. Try to achieve the target with as few additions or subtractions as possible.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3
7. Pre-requisite knowledge/skills, if needed, are identified and make clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3
10. Help and documentation files are provided for students and teachers including contextual	3 see comments

assistance (Accessibility).	
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

Wishball whole numbers clearly presents the learning objectives (whole number operations, visualization, estimation, place value) in the introductory screen of the learning object. It clearly sets out the learning tasks for students and explains how to successfully complete the tasks presented. It does this by presenting students with a series of questions. These leading questions also serve the purpose of conveying instructions to learners. Again the use of a demonstration component helps students understand how the object functions.

Learning Object Review

Title: Environmental evaluation project: frog pond habitat

Explore why a frog population is declining. Look at changes in the pond over time: water quality, habitat loss and predation by introduced species. Build a food web for the pond. Model population interactions. Identify which species have the greatest impact on the frog. Build a report using evidence you have collected to support your conclusions

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	3
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	4
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	4
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	3

Assessment of the Learning Objects, Models and Frameworks

11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	This learning object can be used independently.

Comments

This is the most comprehensive learning object reviewed from Phase One or Phase Two. It incorporates many of the interactive features and pedagogical approaches found in other Learning Federation objects. In many respects, it more closely resembles designs found in larger multimedia CDROM based learning products.

This learning object incorporates many design features which were recommended in the Phase One Report. Features such as the notebook function for students to reflect and record observations during and after exploring the learning object, the utilization of leading questions to generate reflective thinking, the use of visualization to explain complex interactions in complex systems, and the incorporation significant feedback mechanisms for student's as they progress through the learning object all show exemplary instructional design.

The graphical representation of complex scientific relationships is very well executed as is the use of interactive tools to conduct experiments. This learning object shows the potential to provide learners with experiences not normally possible in class or in the schooling-sector.

The inclusion of a notebook function enabling learners to create an artifact is good design.

Two small suggestions are offered to improve this otherwise exemplary learning object. It would be beneficial to have a "book marking" function to allow students to save their location in the object. This would allow them to return to the location that they last left. In addition, some form of mechanism to allow students to save their entries in the notebook to another session would be also beneficial as this learning object will likely require students to return to this learning object over a number of sessions.

Learning Object Review

Title: Wild ride: get a grip

Investigate the role of friction in performance of bicycle tyres. Test how the type of tread affects grip and speed. Choose tyres best suited to track and weather conditions in a time trial.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	4
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	4
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	4
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	4
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	3
11. Design of visual and auditory information enhances learning and mental processes	4

(Accessibility).	
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

This learning object like its companion object Wild Ride-Race Day enable students to engage in activities not easily undertaken in most school-settings (a bike lab). The use of experimentation, hypothesis setting, and experimentation resulting in the recording of results mirrors the scientific method. The ability to save data from experimentation will allow students to further manipulate data in other applications such as a spreadsheet to make further predictions.

In terms of navigation and user interface design, the use of a back button, a replay button and a contextual help button throughout the learning object is required. The use of an "expert" (Professor Bruce Elliott) to explain grip is motivational but could be further emphasized through the use of a video or audio component. It would be beneficial to include additional graphics from a university test lab to link the task to an authentic setting.

Learning Object Review

Title: Wild ride: race day

Prepare a bike for racing. Use a simulator to test how performance is affected by frame type, tyres, wheel size and gears. Test how different combinations affect speed and handling. Then choose equipment and gear shift tactics best suited to track conditions on race day.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	3
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	3
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	3
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3
7. Pre-requisite knowledge/skills, if needed, are identified and make clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	3
11. Design of visual and auditory information	4

enhances learning and mental processes (Accessibility).	
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

This learning object illustrates the potential that digital media has to provide a rich experience to students that cannot be easily replicated in classrooms or school settings. The use of an authentic setting (a race scenario) to motivate and facilitate students to manipulate a number of physical forces, experiment with these forces, estimate their impact on a race situation and test their acquired understandings are very well executed. This learning object used in partnership with "Get a Grip" highlights the potential for developing a series of learning objects and the further potential to ladder knowledge and skills between learning objects.

Learning Object Review

Title: Gold Rush Level 2

Dig for gold on the Ballarat goldfields in 1865. Try your luck at alluvial or shaft mining. Buy a miner's permit, tools and enough supplies to last a month. Discover how hard life was on the goldfields. Explore a map showing the countries migrants left to join the gold rush in Australia. Find out which towns developed due to the discovery of gold. Look at an illustrated timeline to find out how the gold rush led to a boom in the Australian economy and rural development. This is the more difficult level in a pair of activities that differ in complexity of navigation and basic calculations.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	3
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	3
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	4
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	4

10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	2-3
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently by learners

Comments

Like Heroes of the Air, Gold Rush Level 2 illustrates the power of the "narrative" in learning object design. This learning object utilizes elements such as text with audio elements, clear instructions, contextual feedback, and the use of audio tracks to engage the learner to create a highly interactive immersive environment. This learning object utilizes more sophisticated sound effects than those found in other learning objects. Incorporating additional information including tips, maps, a currency converter and information on different types of mining help students gain a deeper understanding of the Ballarat Gold Rush.

The ability to print elements from the learning object (the mining permit) help create a paper record or 'artifact" based on the learner experience. As recommended in other learning objects it is important to provide students with some record of their experience.

Learning Object Review

Title: Heroes of the Air

Explore two historic flights made by Charles Kingsford Smith and his crew. Examine flight logs including photographs and footage. Look at the flight path of the first Pacific crossing in 1928. Retrace the failed Trans-Tasman flight of 1935. Make your own newsreel about the achievements of Australia's early aviators. Recognize that breakthroughs in air transport helped Australia to overcome geographical isolation.

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	2-3 see comments
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	3
4. There are clear instructions for using the learning object (Usability).	4
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	3
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	3
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	3
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	3
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	3
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	2

11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	4
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Can be used independently

Comments

Heroes of the Air, demonstrates the rich opportunities that present themselves when incorporating archival content with an historical narrative. The power of a story to inform students about history holds significant potential in learning object design.

Interactive elements which allow students to create their own story line based upon original materials offers new ways to explore history and the role that documentation/artifacts have in creating our understanding of the past. In many respects, this format is one that best illustrates the notions of "repurposing-reusing" and small within the many definitions associated with learning objects. Many design elements are executed including the availability of text from the original song while students listen to the audio track.

Two suggestions are recommended for this object. First, that in addition to printing a students' final assignment, that it would be beneficial to also save their final project outside the learning object. This would allow for further editing, or its inclusion into another presentation tool for further editing and possible enhancement. A second recommendation is to include links to additional online resources (museums, national archives, university sites) to provide both students and teachers with information that help place historical events and original materials within a wider context.

This LO as well as Gold Rush Level 2 within the Studies of Australia curricular area are illustrative of the growing diversity of instructional designs from The Learning Federation and of the importance that different instructional designs have for disparate curricular areas.

Learning Object Review

Title: Learning Assets

Announcement of Victory 1945 (audio speech)
Banish the Budget Blues (song-audio)
Helping our Heroes (photograph)
Vote "yes" for conscription (QuickTime movie)
The Birth of White Australia 2 (graphic)
Australia's Peril (poster)

Qualities of learning objects	**Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable**
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	4
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	NA
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	NA
4. There are clear instructions for using the learning object (Usability).	NA but recommended (see comments)
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	4
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	NA
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	NA (see comments)
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	4
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	NA
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	NA

11. The author indicates whether the learning object is accessible for learners with diverse needs (Accessibility).	NA
12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	Yes

Comments

Six learning assets were reviewed in this Phase Two Review. The types of objects included digitized historical or cultural content in a variety of media formats (music, quick time movies, still movie images, photographs and original posters). Learning assets are intended for use by teachers to augment instructional materials already available in classrooms. They can also be used by students for student projects or for other learning activities when studying Australian culture and history. The strength of learning assets are their flexibility, small size, and authenticity and originality allowing learning assets to be used when building a lesson or extending and enhancing existing teacher resources. Available as digital files enables teachers and learners access to copyright cleared resources that until recently were unavailable to those in the public education system. In many respects they follow a more traditional resource model where teachers exercise choice about the materials they use for instruction.

Appendix 2

Learning Object Review Template

Title:

Qualities of learning objects	Scale (0) absent, (1) weak, (2) moderate, (3) strong, (4) perfect, (NA) not applicable
1. The content of the learning object is accurate and reflects the ways knowledge is conceptualized within the domain (Integrity).	
2. There are clear learning objectives that are made explicit to learners and teachers (Learner Focus).	
3. The target learners are clearly identified (academic level/technical ability/demographics) and addressed (Learner Focus).	
4. There are clear instructions for using the learning object (Usability).	
5. The technology helps learners to engage effectively with the concept/skill/ideas and structures information content in order to scaffold student learning (Learner Focus-design).	
6. The learning object provides an opportunity for learners to obtain feedback within or outside the learning object (Learner Focus-design).	
7. Pre-requisite knowledge/skills, if needed, are identified and makes clear connections with prior and future learning (Learner Focus).	
8. The learning object stands alone and reflects an awareness of the varying educational environments in which learning sequences and objects may be used (Learner Focus-design).	
9. The learning object is easy to use (i.e. navigation, user control, visibility of system status) (Usability).	
10. Help and documentation files are provided for students and teachers including contextual assistance (Accessibility).	
11. Design of visual and auditory information enhances learning and mental processes (Accessibility).	

Assessment of the Learning Objects, Models and Frameworks

12. The learning object requires instructor intervention to be used effectively in a mixture of learning environments and learning sequences (Learner Focus-Accessibility).	

Comments

Appendix 3

Interview Guide

1. **Demographic**
   a. Can you tell me a little about yourself?
      i. Education
      ii. Work experience?
   b. Why did you first join the TLF initiative and how long have you worked at the TLF?
2. **Position**
   a. What is your position at the Learning Federation?
   b. What do you do and how would you define your responsibilities?
3. **Challenges**
   a. How has your job changed over the past 15 months?
   b. What has been the most difficult aspect of your work with online curriculum content development, (metadata, in-school implementation, quality assurance compliance, managing relationships between TLF and state and territory personnel/multimedia developers, industry liaison, specifications etc.) *Prompt for most appropriate descriptor from TLF organizational chart*
   c. What have you found easier than first expected?
   d. What have been the most challenging aspects pertaining to the mission of TLF? *Prompt for tasks undertaken*,
      i. creating new knowledge,
      ii. working in isolation,
      iii. lack of community of practice,
      iv. externally imposed timelines to achieve results
      v. working with so many stakeholders
      vi. accommodating diverse user environments
      vii. finding skilled personnel who understand the project
      viii. Other
   e. What have you found easier than expected? Why?
4. **Learned Lessons**
   a. What have you learned or "discovered" that you did not know about area of LO's before working for TLF? (Learned Lessons) For example:
      i. Design of LO—types media, size, ability to repurpose
      ii. Creation or development of LO including tools
      iii. Implementation—in classrooms by students and teachers
      iv. Tagging—Metadata
      v. Repository Design
      vi. Quality assurance—why is this so important?
      vii. Commercialization of LO's
      viii. Other
5. **Next Steps**
   a. What do you see as the current and future challenges in the area of online curriculum content and its use in schools across Australasia?

Assessment of the Learning Objects, Models and Frameworks

b. Do you have any recommendations regarding next steps for TLF?
c. If so how would you describe them and/or group them into categories?

6. **<u>Additional Information</u>**

a. What have we not covered that you wish to share with me and my fellow researcher in Canada?