Investigating the factors that influence the use of digital learning resources in the K-12 educational context

Susan J. Bennett
University of Wollongong, sbennett@uow.edu.au

Lori Lockyer
University of Wollongong, lori.lockyer@gmail.com

Ian M. Brown
University of Wollongong, ibrown@uow.edu.au

Investigating the factors that influence the use of digital learning resources in the K-12 educational context

Sue Bennett, Lori Lockyer and Ian Brown
Centre for Research in Interactive Learning Environments
Faculty of Education
University of Wollongong, NSW, Australia
sue_bennett@uow.edu.au

Abstract: Australian and New Zealand governments have made a significant investment in the establishment of an on-line repository that will make digital learning resources, also called learning objects, available to teachers in the K-12 sector. The focus of this, and similar learning object initiatives around the world, has been on content development and delivery. Much of the current learning object research has been concerned with resolving the technical issues to support these processes, with little attention paid to pedagogical and practical issues that might influence learning object use. This paper argues for research to address this gap and reports on a study investigating the factors that influence the use of digital learning resources in the K-12 educational context. The findings of the study are relevant to understanding how learning object approaches can be best conceived of and supported.

Introduction

The practice of reusing resources is not new in education. Teachers and designers are accustomed to developing new learning experiences by reusing ideas and resources previously developed by themselves or others. In the past these resources have been limited to physical media readily at hand, for example books and other printed documents, and video and audio tapes; or information accessed through broadcast media, such as educational television and radio. More recently digital resources have become available, with the Internet increasingly being used as a source of educational resources. The availability of digital resources that can downloaded from the Internet or distributed amongst a network of teachers promises to make educational materials more easily accessible across the globe. This situation has led to the emergence of 'learning objects'.

Australian and New Zealand state and federal governments have made a significant investment in the development of digital resources through *The Learning Federation*, an initiative with funding of $AU 74 million over five years (http://www.thelearningfederation.edu.au/tlf/). Over the period 2001-2006, the initiative aims to create online curriculum content and the infrastructure for the procurement, storage and distributed access of digital learning resources specifically for Australian and New Zealand primary and secondary schools. Currently, the primary focus of the initiative is on developing learning objects to be made available online through a database or repository. The repository is not yet publicly available, although some example learning objects are available on the Web site.

The Learning Federation initiative is just one example of a large-scale project that seeks to make learning objects available to designers, teachers and learners. Similar initiatives have been established in Canada, the United States and Europe at all levels of education (Friesen, Roberts & Fisher, 2002; Laurillard & McAndrew, 2003; Suthers, 2001). The rationale for all of these initiatives is to make digital resources in the form of learning objects freely or commercially available to teachers and designers around the world. The idea behind learning objects is to allow teachers and designers to search for appropriate learning materials to reuse within their own learning settings.

Over the past few years, a range of definitions for learning objects has been put forward (McGreal, 2004). Some of these definitions are broad, encompassing "any entity, digital or non-digital, that may be used for learning, education or training" (IEEE, 2002, p. 3). Others argue that for a digital resource to be considered a learning object, it must have some instruction inherent in it (Downes, 2003). Analogies and metaphors have also been used to reach an understanding of what a learning object is.

Learning objects have been likened to Lego blocks that could be "assembled into literally any shape, size, and function" (Hodgins, 2000. p.8). This encapsulates the notion of standardization that would allow learning objects to be joined together. A less limiting conception envisages learning objects as blocks of a variety of shapes and sizes held together by mortar (Wiley, 2003a). Common to all of these conceptions of learning objects is the notion of reuse, which is underpinned by three assumptions (Agostinho, Bennett, Lockyer, & Harper, 2004):

1. Teachers and instructional designers will be willing to use other people's learning objects.
2. Learning objects will be accompanied by a standard annotation to allow them to be found easily.
3. When retrieved, teachers will know how to make effective use of learning objects within their instructional setting.

Leaving aside the first and third points for a moment, for a learning object to be found it must be stored in a location from which it can be easily accessed, and it must be described by a record in a standard format to facilitate its retrieval using a search engine. It is the technical aspects of these storage and retrieval processes that have dominated the learning object research and development effort to date (Bannan-Ritland, Dabbagh & Murphy, 2002). On the other hand, little attention has been paid to investigating the other two assumptions listed above. These suggest that pedagogical and practical factors relating to the reuse of digital materials will also be important. Wiley (2002) has argued that if these types of issues are not addressed in the research base "we will find ourselves with digital libraries full of easy-to-find learning objects we don't know how to use" (p. 1). Additionally, tools are needed to ensure that learning objects can be incorporated in "predictable, interoperable, and reusable ways" (Anderson, 2003, p. 19).

Knowledge of how teachers and instructional designers can make effective use of digital resources is needed to develop support strategies upon which such technical tools might be based. This is particularly important in the school education sector in which teachers generally work alone or in small teams to integrate technology into their classrooms and do not have access to expert designers or technical staff to assist them. Specifically, more needs to known about teachers' current understandings and uses of digital resources, and what approaches may be effective in enhancing their approaches.

The study reported in this paper has sought to address this gap in understanding by investigating how teachers integrate digital resources into their teaching and how they might be supported to overcome some of the limitations they identify through learning design frameworks. The use of generic learning designs, based on effective pedagogical strategies, has been suggested as one approach by which to support teachers and designers develop materials that incorporate learning objects (Laurillard & McAndrew, 2003; Wiley, 2003b). Recent research has shown that learning designs can be used to provide a scaffold for university teachers when customising a learning design to their own contexts (Bennett, Agostinho & Lockyer, 2004). As yet there has been no research conducted to investigate the feasibility of such an approach for K-12 teachers.

As most of the investment in learning objects in Australia has been made in the school sector, the study focused on K-12 teachers. By providing the teachers' perspective on digital resources learning objects the findings of the study begin to address the imbalance between research on the technical aspects of learning object use and research on the pedagogical and practical aspects. The aims of the study were to:

- Identify the pedagogical and practical factors that support and constrain use of digital resources,
- Characterise the processes and decision-making steps involved in selecting and integrating digital resources, and
- Determine the role that learning design frameworks can play in supporting effective use of digital resources.

Research design, methods and techniques

This research was carried out in a workshop setting in which teachers were introduced to digital resources, repositories and learning design templates, and then supported as they applied these to their own contexts. This approach enabled the researchers to explore teachers' ideas about incorporating digital resources and investigate the processes by which they designed, developed and implemented materials based on the digital resources and learning objects they found. The process was facilitated by the research team, but was sufficiently open-ended to allow participants to explore the issues relevant to their contexts.

The study began with the recruitment of K-12 teachers from public and Catholic schools the Wollongong-southern Sydney area to participate in the study. Teachers were contacted through their schools and invited to take part in a series of free evening workshops that would help them make effective use of digital resources in their teaching. Teachers were made aware that the workshops were part of a research study and their informed consent was obtained prior to the commencement of the sessions. The researchers sought to attract teachers from a range of grade levels and disciplines, and with varying levels of technical skill. Four workshop series were held over two school terms with a total of 56 teachers participating.

Two types of workshops were offered to cater for different interests and levels of previous Web authoring experience. One workshop series was designed for teachers who had not previously created Web sites and so focused on introducing them to basic Web design and development skills within the context of creating a Web site to support a learning activity for their class. A second series of workshops, intended for teachers who were already familiar with how to create Web sites, focused on the design and development of WebQuests. Both workshops series oriented the participants towards the creation of Web sites they could integrate into classroom activities they had planned for the coming term. *Dreamweaver* was chosen as the Web authoring tool because it is increasingly becoming available in local schools due to affordable educational site licensing arrangements. This meant that there would be a high level of interest from teachers who wanted to learn to use this software. The workshops were designed to allow teachers to explore the use of *Dreamweaver* in a purposeful way considering their contexts, rather than focusing on learning technical and production skills alone. Thus the workshops had an emphasis on good pedagogical design together with appropriate use of multimedia resources and visual design techniques.

Through the program of four workshop sessions, the participants were:
- introduced to learning objects and other digital resources, and how to locate them on-line;
- provided with generic learning design templates which they used as the basis for the activities they designed and developed;
- supported with technical assistance with building their Web-based activity using *Dreamweaver* software;
- assisted to complete their Web site and share their implementation ideas with other participants.

Data was collected before, during and after the workshops sessions as detailed in Table 1.

Stage	Data collection	Rationale	Research sub-question
Before the workshop	Participants completed a questionnaire that collected background information about them and their experiences with digital resources.	This helped the researchers to characterise participants' teaching practice, technical skills and pre-conceptions about digital resources.	What are teachers' initial experience using technology and digital resources in their teaching? What prior experiences to teachers have in using digital resources?
During the workshops	Data collection was integrated into the workshop program. Data was collected in the form of overt observations, records of discussions, and artefacts produced by the participants.	The data collected was used to investigate the processes by which teachers selected and incorporated digital resources into the design of their Web-based lessons.	What criteria do teachers use when deciding to use digital resources? How do teachers integrate digital resources into their particular context?

Stage	Data collection	Rationale	Research sub-question
After the workshops	Through semi-structured interviews, participants were asked how their ideas about digital resources had changed, about the process by which they developed their Web sites, and how they intended to implement them in the classroom. A further interview was conducted after the site had been implemented.	Data from this stage provided further evidence about teachers' ideas about using digital resources, in particular the factors that support and constrain use/re-use; and whether the learning design templates used assisted the design process.	How do teachers' ideas about using digital resources in their teaching change? How does a generic learning design template support teachers in making use of digital resources?

Table 1: Data collection techniques used in the study

Preliminary findings and discussion

Background experience of the participants

The group consisted of 44 primary (elementary) teachers and 12 secondary teachers, across a range of grade levels from kindergarten to Year 12. Most were experienced teachers with 33 having more than 20 years of teaching experience, 14 with between 10 and 19 years experience, 4 with between 5 and 9 years experience, and 5 participants with less than 5 years of experience. The majority (84%) of participants rated themselves as being comfortable or very comfortable with computers, with the remainder nominating themselves as slightly uncomfortable when using computers. None rated themselves as being very uncomfortable with computers. Most participants (61%) were new to Web authoring, with the remainder rating their Web authoring skills as intermediate. Of this latter group, the most commonly used software packages were *Claris HomePage* and *Microsoft FrontPage*. Only nine participants had used *Dreamweaver* previously.

When asked how they generally used technology in their teaching the teachers indicated the following:
- Networked communications as part of classroom activities with their students (17 participants)
- Teacher productivity tools to monitor and organise information (38 participants)
- Encouraged student use of software to create or manipulate data for assignments (52 participants)

All but three of the participants used digital resources in their teaching. When asked to describe their use of digital resources further, their responses could be categorised as follows:
- Use of the Internet by teachers and/or students (41 participants)
- Use of software to support particular curriculum areas including CD-ROMs (15 participants)
- Teacher and/or student use of tools (32 participants)
- Teaching of computer skills (7 participants)
- Use of specific hardware, such as cameras, CD burners (5 participants)
- Development of own Web-based teaching resources (4 participants).

Overall, the most of the teachers participating in this study were experienced professionals who were comfortable with computer technology and using it in their classrooms. The participants interpreted 'digital resources' as referring to a wide range of computer-based activities, including the use of software tools and hardware. Many of the activities they described were open-ended and learner-centred. The majority of the participants were using the Internet to some extent; mainly to research topics they were teaching or in research activities they set for their students. It appeared that a small number of teachers were creating their own teaching resources from digital photos

or video they had captured, and that many also facilitated student production of presentations and documents. Many teachers noted the use of content resources in the form of bookmarked Internet sites and curriculum-focused software packages to support literacy and numeracy. None specifically noted that they downloaded resources from the Internet and integrated them into their own presentations or teaching materials, and few had previously developed their own Web-based learning materials.

Observations and field notes from the workshops

Discussion during the workshop sessions allowed the researchers to explore the participants' ideas about digital resources as they were introduced to new resources and tools. The researchers also recorded field notes while observing the participants' activities. A preliminary analysis of the patterns in this data has revealed to major themes. These are outline below with illustrative quotes from the participants using pseudonyms.

Initial discussion about the value of digital resources in teaching revealed that although the participants were generally interested in using multimedia content from the Internet most were only using such resources in limited ways and did not consider it vital to their teaching. However there were some comments about what the teachers saw as an inevitable move towards a greater emphasis on digital content:

> *You see the whole of teaching moving towards a greater use of digital resources. I guess it's just another thing we're probably going to be making more and more use of. (Caitlyn)*

The participants expressed their frustrations at not being able to find good resources on the Internet. Some teachers commented that finding appropriate resources took a lot of time:

> *[Finding good resources] is the hard part. I'll spend days finding appropriate resources. And you have to screen them. (Simon)*

The researchers introduced the participants to several repositories of digital resources (such as MERLOT and Picture Australia); sites that allowed the participants to search repositories (such as EdNA); and other online sources for learning materials (such as the NASA site). These were chosen on the basis of topic areas the participants had nominated that they would be focusing on. Observations of the participants searching the sites and discussion about what they had found revealed the distinguishing features of a good search site as:
- A simple search mechanism with limited text on the opening screen.
- Comprehensive content so that there were sufficient finds from a particular search.
- Information about what grade the material was suitable for should be included.
- Material relevant to the curriculum was available and, in this case, of Australian origin.
- Ratings or an indicator of relevance (as a percent) were also considered useful.

In addition to the repositories identified by the researchers, the participants used either Web sites already known to them or links found using general Internet search engines. The former were either curriculum sites, for example the site of the state educational authority, or organisations from which they considered relevant, authoritative information would be available, for example the national weather bureau site. The preferred search engine was *Google*, although others that specifically indexed Australian Web sites were also used. For most participants, *Google* was the default tool when they did not already know of a site likely to offer the resources they wanted. This was despite receiving a large number of irrelevant items returned as a result of their searches, a frustration which was identified by many participants:

> *I've always used search engines, but I'm too general and I come up with five million hits. (Valerie)*

When choosing to use a particular resource from those that they had found, participants noted the following keys considerations:
- Selecting resources with an appropriate reading level, especially for younger learners.
- Choosing visually engaging resources that would be consistent with the design of their sites.
- Resources needed to be freely available with clear information about copyright conditions.

- Consistency with the topic and the learning objectives were essential.
- Sites needed an adequate depth of information that wasn't too complicated.

Discussions with the participants highlighted the difficulties they experienced in finding information suitable for the literacy levels of primary schools students and which was sufficiently focused on the topics they had chosen. Some Web-based resources were too large in scope or too general to be useful in supporting the learning activities they had designed.

The above findings suggest that teachers had difficulty locating appropriate educational resources on the Internet. General-purpose search engines returned too much unrelated information or information not suitable for educational use. It would seem that repositories of digital learning resources have potential to address these problems provided they include simple search mechanisms that are geared to the questions teachers ask when looking for and choosing a resource.

Further data analysis

The researchers completed the final interviews in December 2004. Analysis of these and further analysis of the observational data from the workshops will be carried out in early 2005 to provide additional insights into the participants' design decisions and use of the learning designs. The final versions of the Web materials created by the participants are also yet to be analysed.

Conclusion

Understanding how teachers view and use digital resources is fundamental to understanding how they might make effective use of learning objects. The study described in this paper is beginning to provide some insights into the issues faced by teachers as they try to locate and select appropriate digital resources to incorporate into their own teaching. The participants in this study were interested in using digital resources, but found it difficult to locate high quality resources that were appropriate for their learners. This may be partly due to their limited awareness of existing repositories of digital learning resources, a lack of effective search strategies and the limited suitability of many of the resources available. Further analysis of data collected as part of this study will focus on the participants' design decision and their use of learning design templates.

Acknowledgements

References

Agostinho, S., Bennett, S., Lockyer, L. and Harper, B. (2004). Developing a learning object metadata application profile based on LOM suitable for the Australian higher education context. *Australasian Journal of Educational Technology*, 20(2), 191-208.

Anderson, T. A. (2003). I Object! Moving Beyond Learning Objects to Learning Components. *Educational Technology*, July-August, 19-24.

Bannan-Ritland, B., Dabbagh, N., & Murphy, K. (2002). Learning object systems as constructivist learning environments: Related assumptions, theories, and applications. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects* (pp. 61-98). Bloomington, Indiana: AIT/AECT. [Online]. Retrieved October 2002, from http://reusability.org/read/chapters/bannan-ritland.doc.

Bennett, S. Agostinho, S., & Lockyer, L. (2004). Investigating how learning designs can be used as a framework to incorporate learning objects. In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds.), *Proceedings of* the *Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 116-122). Perth, WA: ASCILITE.

Downes, S. (2003, July 31). *Design, Standards and Reusability*. [Online]. Retrieved January 2004, from http://www.downes.ca/cgi-bin/website/view.cgi?dbs=Article&key=1059622263

Friesen, N., Roberts, A., & Fisher, S. (2002). CanCore: Metadata for Learning Objects. *Canadian Journal of Learning and Technology*, 28(3). [Online]. Retrieved March 2003, from http://www/cjlt.ca/content/vol28.3/.

Hodgins, H. W. (2000). The future of learning objects. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects: Online Version*. Retrieved December 2004, from http://reusability.org/read/chapters/hodgins.doc

IEEE. (2002, 6 September). *1484.12.1 IEEE Standard for Learning Object Metadata*. [Online]. Retrieved January 2004, from http://ltsc.ieee.org/

McGreal, R. (2004). Learning Objects: A Practical Definition. *International Journal of Instructional Technology and Distance Education, 1*(9). [Online]. Retrieved December 2004, from http://www.itdl.org/Journal/Sep_04/article02.htm.

Laurillard, D. & McAndrew, P. (2003. Reusable educational software: A basis for generic learning activities. In A. Littlejohn (ed.) *Reusing Online Resources: A Sustainable Approach to E-learning* (pp. 81-93). London: Kogan-Page.

Suthers, D. D. (2001). Evaluating the Learning Object Metadata for K-12 Educational Resources. *IEEE*, 371-374.

Wiley, D. A. (2002). Learning objects. In A. Kovolchick & K. Dawson (Eds.) *Educational Technology: An Encyclopedia*. Santa Barbara: ABC-CLIO. [Online]. Retrieved April 2003, from http://wiley.ed.usu.edu/docs/encyc.pdf.

Wiley, D. A. (2003a) Design Perspectives: Introduction. In A. Littlejohn (Ed.). *Reusing Online Resources: A Sustainable Approach to E-learning* (pp. 77-79). London: Kogan-Page.

Wiley, D. A. (2003b). Learning objects: Difficulties and opportunities. Academic ADL Co-Lab News Report: No. 152-030406. [Online]. Retrieved April 2003, from http://wiley.ed.usu.edu/docs/lo_do.pdf.