Digital Learning Objects: A Need for Educational Leadership

The benefits and challenges of using Digital Learning Objects in the classroom.

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Introduction[1]

Despite increasing interest in technology-assisted education, technology-based instructional design still lacks support from a reliable body of empirical research.[2] This dearth of reliable information hampers its integration into mainstream school systems. In fact, many teachers remain resistant to using technology in the classroom.[3] In order to encourage uptake of new educational technologies, Roblyer argues that fundamental research on the potential impact of technology on school life must be conducted.[4] This line of inquiry needs to offer a clear research agenda and provide evidence that will help drive effective classroom practice. Indeed, in Roblyer's view, it is only when the impact of technology on school life is clearly articulated and demonstrated that educators will start to adopt technology widely.

In order to overcome teacher resistance to technology in the classroom, we have sought to follow a process described by Friesen to evaluate the advantages and disadvantages of the educational use of digital learning objects (DLOs) from the teachers' point of view.[5] This article explores the opportunities and challenges inherent in using digital learning objects and reports on the impact of DLO use at both the classroom and school levels. By providing research that links students' use of DLOs with the development of key competencies, we hope to sharpen teachers' visions of how DLOs can help them achieve their educational goals, and to encourage DLO uptake for educational purposes. Finally, we envision a DLO that can assist school principals in the facilitation of educational leadership and help transform teachers' attitudes toward technology-based teaching.

DLOs in the classroom: opportunities and challenges

A digital learning object is 'any digital resource that can be reused to support learning'.[6] DLOs can be used in a variety of ways to support learning in every subject area. For example, in mathematics, to help students rehearse long multiplication or equation solving; in science, to help students understand tectonics and other complex concepts; in language arts, to guide creative writing and critical thinking exercises; and in social studies, to illustrate concepts in civic education and complex decision-making processes. A myriad of examples of DLOs can also be found at the Multimedia Educational Resource for Learning and Online Teaching (MERLOT.)

Teachers in primary, secondary or tertiary education use DLOs in a variety of ways to meet curriculum needs and address different learning abilities amongst their students. DLOs enable students, both individually and collaboratively, to work 'hands-on' with complex content and ideas. Students can, for example, manipulate and experiment with variables, carry out simulations, prepare exhibitions with authentic artefacts, and explore new concepts in game formats. DLOs challenge students to question, investigate, analyse, synthesise, problem solve, make decisions and reflect on their learning. Finally, DLOs enable students to work at their own pace and can provide scaffolded learning tasks[7] that offer real-time feedback on performance in a variety of supportive and engaging ways.

That said, DLO integration inevitably creates challenges; teachers need to invest extra time and energy learning about and implementing DLOs[8] and overcoming the technological challenges that come with any innovation.[9] Our previous research demonstrated that complex factors affect the learning value derived by students from DLOs.[10] Once DLOs are integrated into the classroom, how they are used and what benefits they provide are shaped by the teacher's technological competency and preferred teaching modes.

Background

The following trial describes the latest in a series of trials related to the use of DLOs in schools, and follows on from earlier work undertaken by the authors exploring the use of 'custom built' DLOs to support learning goals in lower secondary school history classes.[11] The project was part of an initiative supported by the Microsoft Partners in Learning Programme, which has as its broad goal the enhancement of practices in using ICT in schools, through the provision of research and teacher professional learning opportunities.

Early projects in this series examined the use of 'purpose built' DLOs in a Wellington secondary school, and were designed to support learning outcomes for students studying a topic on 'New Zealand Disasters'. These learning objects were specifically designed for the purposes of the teaching unit and used the teachers' planning and identified student learning outcomes as the basis for decisions related to form and content. Individual objects were designed containing a range of information and learning activities relating to well-known disasters, including the sinking of the ferry *Wahine* in 1968, the 1931 Napier earthquake and the Tangiwai rail disaster of 1953. These objects were primarily text-based and were delivered via the Mindspring[12] learning management system.

Outcomes from these early trials indicated significant potential for learning objects to support cooperative and collaborative development, and to assist students in the development of specific topic-related knowledge and higher order thinking skills. While these early projects were hampered by significant technical difficulties mainly associated with the limited bandwidth available to deliver the DLOs via Mindspring, analysis of the resulting student discourse captured via Camtasia and as recorded by researcher observations and in follow-up interviews, indicated clearly the capability which existed for appropriately designed learning objects to act as learning 'Microworlds'. In these Microworlds students were able to collaboratively negotiate meaning, solve increasingly complex problems and assimilate information from a variety of sources in developing reports and summaries.

While such potential existed, however, the study also alluded to issues related to the sustainability of the 'custom built' approach to developing these objects. While from a teaching and learning perspective developing DLOs 'from the ground up' using teacher learning outcomes as their basis was effective, in terms of the costs involved in doing this, ongoing use of this strategy proved impractical.

The main value from these early studies was in terms of identifying the capacity of DLOs to support an individualisation of student learning and to scaffold students as they developed and refined new knowledge and skills, or interacted with each other in novel learning situations. They also alluded to the importance of leadership in this process, which is one of the main focuses of the study detailed below.

1 This article was adapted from a presentation given to the Royal Society of New Zealand in December 2007. It draws on Robin and Annick Janson's article, "Integrating Digital Learning Objects in the Classroom: A Need for Educational Leadership", *Innovate: Journal of Online Education* 5, no. 3 (2009).

2 D. Wiley, *Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy*, 2002.

3 L. F. Johnson, *Elusive Vision: Challenges Impeding the Learning Object Economy* (Macromedia white paper), 2003; C. Shayo and L. Olfman, "The Learning Object Economy: What Remains to be Done?", *Advances in Management Information Systems* 5 (2003); and *Learning Objects: Theory, Praxis, Issues and Trends*, eds. A. Koohang and K. Harman (Santa Rosa: Informing Science Press, 2007).

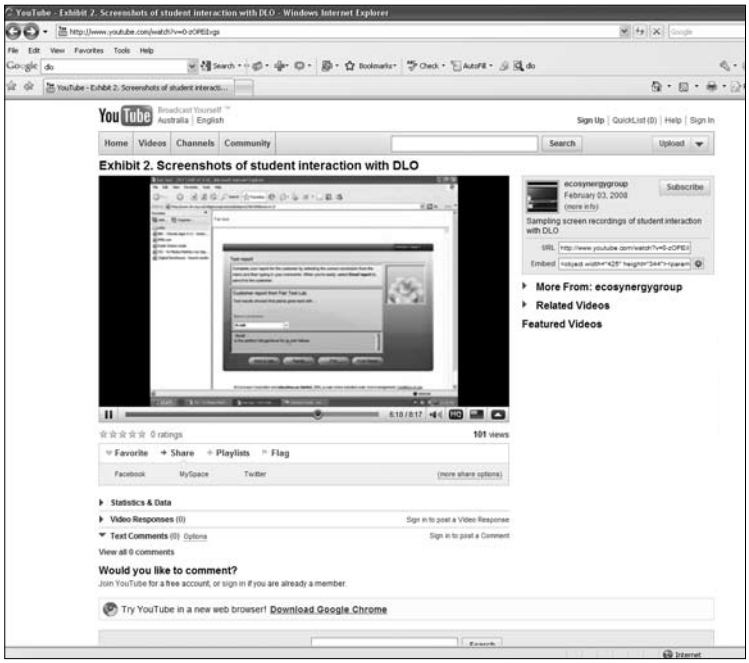
4 M. D. Roblyer, "Educational Technology Research that Makes a Difference: Series Introduction", *Contemporary Issues in Technology and Teacher Education* 5, no. 2 (2005).

DLOs: classroom impact

In this study our research objective was to explore the impact of DLO integration into classroom activities for both individual teachers and the school at large, thereby broadening the scope of our research from students to educators. The project involved five schools over four years of work; other portions of the project are reported elsewhere.[13] In each school the research team allowed participating teachers to guide the choices of topic and particular DLOs which were used. This article presents the experience of eight teachers and 200 students (aged 8–10) in a small primary school in Wellington, New Zealand.

The school joined the programme after its principal answered a call for research participants; her intention was to use the opportunity to expose her staff to new ideas and teaching tools. Teachers had varying backgrounds and skill levels in the use of information communication technologies (ICTs). While one teacher had a university degree in ICT, others started with only a rudimentary familiarity with Microsoft Office applications. None of the teachers had any former experience with DLOs.

Firstly, we briefed the teachers who volunteered to participate and then engaged them in a professional learning programme on DLO use. The briefing included a discussion about their upcoming teaching interests and challenges and information on DLOs available from the Learning Federation. The teachers expressed an interest in using DLOs to teach science as the science and technology fair was approaching, and in consultation with the teachers a subset of three DLOs supporting the learning goals were made available to the research classes (Exhibit 1 can be found at http://www.innovateonline.info/extra.php?id=3019). In each lesson, the teachers introduced the topic under study and presented the material via a data projector so the whole class could see some examples of DLO work and understand the possibilities offered by the learning objects. The students then worked in pairs, as is customary in the school for in-class assignments, with the teachers being available for support and facilitation. Students worked with the DLOs according to their level of proficiency and learning preference; each was allowed to work at a pace that supported their individual learning needs (Exhibit 2: http://www.youtube.com/watch?v=0-zOPEiIxgs), see above.



All DLO work was carried out during class time within the same yearly study block, as students prepared their science and technology fair presentations. This procedure was consistent across classes to ensure that all students experienced, as much as possible, the same conditions. Students used DLOs for two school terms while the teachers recorded their reflections on students' learning in reflective journals. We also interviewed the teachers and members of the school leadership team before and after the trial. We then analysed data from these interviews and reflective journals for recurring and common themes.[14] The results of this analysis suggested that there are three levels at which DLOs can have significant impact.

Impact on student learning

The teachers with whom we worked integrated DLOs into their lesson plans to address different teaching challenges, starting with the preparation of students for the science and technology fair. The greatest challenge inherent in this project was that teachers were only allotted twelve weeks in which to 'coach' their students in competencies related to producing a quality science fair entry. In this time, teachers had to introduce and teach the concept of fair testing and then encourage students to come up

5 N. Friesen, "Three Objections to Learning Objects and e-learning Standards" , in *Online Education using Learning Objects*, ed. R. McGreal (London: Routledge, 2004), 59-70.

6 D. Wiley, "Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy", in *The Instructional Use of Learning Objects*, ed. D. Wiley (2000), 7.

7 *Thought and Language*, eds. L. S. Vygotsky and A. Kozulin (Cambridge: MIT Press, 1986).

8 J. M. Wetterling and B. A. Collis, "Sharing and Reuse of Learning Resources across a Transnational Network" , in *Reusing Online Resources: a Sustainable Approach to Learning*, ed. Allison Littlejohn (London: Kogan Page, 2003), 182-194.

9 P. Freebody, *Evaluating TLF's Online Curriculum Content Initiative: Summary of Findings from Surveys, Site Visits and a Field Experiment, 2007*. See http://www.thelearningfederation.edu.au/for_jurisdictions/research_and_trials/research2007.html (accessed 9 June 2008).

'Through this project, teachers ... actively reviewed teaching methods that had been constrained by the school's physical facilities, such as the lack of a science laboratory and suitable equipment ...'

with their own experimental designs, test their hypotheses, reach conclusions and construct visual displays to present their experiments and results. The sooner students mastered the concept of fair testing, the more time they had to invest in designing their own experiments. The laboratory facilities used to carry out the fair-testing demonstrations vary widely across schools, disadvantaging smaller and less well-equipped schools like the primary school in which our study was carried out.

A complex chain of thinking skills supports students' processes of presenting a science project, from mastering fair-testing concepts to applying those concepts in crafting new hypotheses, and finally to designing ways to test those hypotheses. Students use prior knowledge and then interpret, implement, analyse and evaluate to create a new 'product'. To borrow Anderson and Krathwohl's categories,[15] this process involves moving from lower-order thinking processes (for example, remembering, understanding and applying) to higher-order ones (for example, analysing, evaluating and creating). Guided by their teachers, students working on fair-testing DLOs from the Learning Federation completed their science fair projects and entered display boards in the regional competition. They then produced digital stories to describe their uses of DLOs (Exhibit 3: http://www.youtube.com/watch?v=tME4NP9ukw0).

Our analysis of these projects suggests that students' motivation to engage with the DLO tasks was high; additionally, teachers reported achieving the learning outcomes they had set for these units.[16] Teachers felt that the DLOs allowed them to overcome significant difficulties presented by the lack of science laboratories in the school, which had hampered previous efforts to teach fair testing. Teachers' post-intervention evaluations showed that they thought the use of DLOs was equivalent to having a 'virtual lab' and that DLOs made fair-testing teaching more efficient (Exhibit 4: http://www.youtube.com/watch?v=Vs2yKvQOMTI). They attributed their success in preparing students for the science fair to the unique learning scaffolding afforded by the DLOs, and described class examples where learning had taken place and was being transferred into other activities (Exhibit 5: http://www.youtube.com/watch?v=lPSvxoUuomg).

Impact on teacher practice

Through this project, teachers became involved in building their personal knowledge bases. They engaged in testing various DLOs against their teaching objectives and compared the relative advantages and disadvantages of specific DLOs for their particular student populations. In doing so, they actively reviewed teaching methods that had been constrained by the school's physical facilities, such as the lack of a science laboratory and suitable equipment, which had limited the number of students who presented projects to the national science fair in previous years. The expansion of this knowledge helped teachers craft more challenging learning objectives, which led to a significant increase in both the number and quality of submissions. This progress was further recorded when teachers, after implementing DLOs, took the opportunity to expand on their managerial skills, or risked venturing into new territory by mastering additional educational software. One of the teachers reported that working as a team leader for this project helped her expand her managerial skills by providing novel situations for the team to identify, discuss, and solve the teaching challenges they experienced. She reported that her role as team leader was strengthened by these positive experiences and that word of the project and her team's work had spread through the school, raising other teachers' interest in the intervention.

The research also opened a window of time and enthusiasm, stimulating additional professional learning

10 G. W. Falloon, A. Janson and R. Janson, *Impact Study: The Microsoft Digital Learning Object Project, research report prepared for Microsoft New Zealand* (April 2007).
11 See note 10 and G. W. Falloon, "What Works and What Doesn't with Digital Learning Objects", paper presented at the International Conference of Technology in Education, Singapore, September 2006.
12 http://www.unisys.co.nz/about__unisys/news_a_events/mindspring__launch__enables__kiwi__students__.htm.
13 See the authors' "Digital Learning Objects: Towards an Understanding of their Value in Supporting Key Competencies within the New Zealand Curriculum Framework", paper presented at the Australian Council for Computers in Education Conference, Canberra, September 2008.
14 C. Geertz, *Local Knowledge* (New York: Basic Books, 1983).
15 *A Taxonomy for Learning, Teaching, and Assessing: a Revision of Bloom's Taxonomy of Educational Objectives*, eds. L. W. Anderson and D. R. Krathwohl (New York: Longman, 2001).
16 G. W. Falloon, "What Works and What Doesn't with Digital Learning Objects".

'The educators involved displayed leadership in transforming organisational culture ...'

involving exploration and mastery of other education software and tools to complement the DLOs. The teachers described this as significant because there was too little time for them to engage in such exploration in the course of their usual teaching duties. In shaping their own professional development, the participating teachers displayed self-leadership[17] as exemplified in the team leader's account. This self-leadership formed the basis for their 'reaching out' to other teachers later, thus spreading the impact of their experience from individual and team levels to the school as a whole.

School-wide impact

Observing that some of the main challenges she faced relate to the slow uptake of technological innovation by her staff, the school's principal saw participation in the research as an opportunity to open the topic for discussion amongst all teachers, rather than leaving it as primarily her responsibility. As the study progressed the principal concluded that her leadership role was one of facilitation (Exhibit 6: http://www.youtube.com/watch?v=N6snWziNxyg). Rather than taking a 'top-down' approach she attempted to facilitate technology adoption among teachers in a way that gave them ownership of the transition.

The impact of this intervention registered at the school level, changing pedagogical practice and raising organisational awareness of the effect of technology on learning. Participant teachers discussed, both formally and informally, their experiences in the research with their colleagues, who reacted positively and showed interest in being involved. During the school review of yearly teaching activities the teachers who had participated in the research led the movement to adopt the practice of DLO-enabled fair-testing teaching for the following year, as a school-wide policy. As a result, the teachers decided as a group to implement DLO use school-wide.

The team leader for the teachers who had participated in the research presented the results of the intervention to the school's Board of Trustees and discussed the technological issues that needed to be addressed to enable school-wide application of this new pedagogical tool. This presentation prompted the Board of Trustees to approve funding for additional technology to facilitate more widespread adoption of DLOs, including interactive whiteboards to supplement the data projectors that teachers had been using to present DLOs to their classes.

This change across the administrative levels of the school resulted from the early adopter group sharing their experiences and the positive results of DLO-facilitated learning with their peers, during a formal presentation to the teaching staff and in informal conversations. Thus, the educators involved displayed leadership in transforming organisational culture, extending the effect of their experience beyond the level of their personal development to create change at the school level.

Sharing the learning

In order to capitalise on these successes, our next step has been to develop a DLO for professional development within a school. This new DLO, Microsoft e-Leadership Learning Object (MELLO), currently in prototype, will assist school principals in facilitating the transformation of teaching practice in their schools to make the best use of ICT resources. The rationale for the MELLO is that peer information combined with a 'hands-on' approach to learning can play a significant role in encouraging the uptake of new practices with ICT.

The MELLO prototype platform integrates:

- Video interviews with the early-adopter teachers and school principals regarding their experiences;
- Video clips of student-teacher interactions;

- Screenshots and multimedia submissions of student work, including e-portfolios;
- Text documents describing the rationale for using technology-enhanced teaching methods; and
- Video footage of teachers describing how they overcame initial reluctance to technology-supported teaching and learning activities.

The platform is designed to allow for the addition of material relevant to different school environments or other educational contexts, and is structured to organise material thematically with searchable categories with an architecture supporting web distribution via a SharePoint server on the Australia-New Zealand Innovative Teacher Network. The prototype will be tested with school principals and teachers so that its impact on educational leadership development can be evaluated. Following proof of concept, the MELLO pilot may be broadened and tested as a means of facilitating innovation uptake. This effort will involve dissemination via Windows Mobile platforms.

Since the MELLO is programmed to tailor information to participants' specific questions or concerns, we hope to decrease the likelihood of user resistance.[18] The MELLO guides transformative practice and records evidence of learning by:

- Capturing participants' existing knowledge and new questions as they arise;
- Offering a series of learning activities;
- Recording participants' ratings of each activity;
- Capturing post-learning reflection;
- Encouraging sharing of select elements with peers or other interested parties via onsite e-mail functionality; and
- Scaffolding a change process that encourages users to articulate new personal aims and develop an action plan to put necessary changes in teaching practice into place.

In order to encourage multiple learning experiences with the MELLO, participants' data is recorded in the database as a 'learning journey' (with users' consent). With each use, the participant can either print or save his or her learning journey for future reference or share it with peers and mentors, allowing refinement and deepening of professional development. This capability ensures that the database grows with each use, adding multiple perspectives on the issue being explored.

Conclusion

Results from this study support Freebody's assertion that DLO integration in school-wide learning activities requires different types of school leadership at different uptake stages.[19] These results are also consistent with the three years of research we have conducted with Microsoft New Zealand's Partners in Learning Programme. The ripple effect of the intervention on pedagogical practice and learning outcomes spread to the school as a whole, reinforcing Joel Barker's assertion that 'information technology in education has a transforming effect on the setting or institution itself'.[20] Moreover, DLOs have another unique role to play in educational leadership development: DLOs can be designed to help educators overcome their initial resistance to innovation uptake and understand the powerful teaching potential technology-rich learning environments represent. School principals wishing to build collective capacity and professionally develop their staff are already experimenting with the unique learning modes enabled by DLOs. In this way, early adopters of educational technology can display leadership in facilitating transformational e-Learning experiences for their peers.

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17 A. Bryman, "Qualitative research on leadership: A critical but appreciative view", *Leadership Quarterly* 15, no. 6 (2004): 729-769.

18 *Theory, Praxis, Issues and Trends*, eds. A. Koohang and K. Harman.

19 P. Freebody, E*valuating TLF's Online Curriculum Content Initiative*.

20 J. L. Morrison, J. Barker and S. Erickson, "A New Way of Thinking about Technology: an Interview with Futurists Joel Barker and Scott Erickson", *Innovate* 2, no. 4 (2006): 19.