“Learning Objects” have become the new buzzwords for education, both here and overseas. Taking many possible forms, they offer exciting new possibilities for teaching and learning. This session explores some of the experiences this year as the ACT has moved towards early implementation in schools across all sectors. Do they “stand alone”? Are they “teacher-proof” or are they only as good as the teacher that uses them?

“If one changes the tools of thinking available to a child, his mind will have a radically different structure.” (Vygotsky, 1978)

“Neither hand nor mind alone, left to itself, would amount to much. But what are these additional tools that perfect them?” (Sir Francis Bacon, in Vygotsky, 1987)

“The most effective kind of education is that a child should play among beautiful things.” (Plato, 427-347 BC)

What constitutes excellence in teaching in teaching and learning? What is the role of Information and Communication Technologies (and learning objects in particular) in this process? Indeed, what do we mean by a “learning object”? In seeking answers to these questions, it is necessary to be very clear about both our meanings and assumptions concerning the “big ideas” involved.

Excellence in pedagogy

Beginning ambitiously with the idea of excellence in pedagogy has been made a little easier in recent years with explicit attention being paid, not only by researchers but by Government education authorities, who have begun to formally embrace ideas and practice associated with “authentic” (Newmann, 1996), “productive” (EQ, 2001) and “quality” (D.E.T., 2003a, 2003b) pedagogy. Such models offer teachers both a research-grounded framework and a language by which they can recognise and describe features of their own teaching and classroom practice which may be contributing to or detracting from quality student learning. I suspect that teachers have always been able to recognise aspects of quality in their own practice and that of others, but this knowledge has generally been tacit and difficult to articulate. My own experience in moving back and forth between schools and universities over the past decade has made it clear to me that identifying and describing positive and negative aspects of my teaching was no trivial matter. For many of us, good teaching practice becomes automated and subliminal over many years. Making good practice explicit has been a challenging learning experience for me.
It may have been this experience which caused me to respond this year with such positive recognition to the quality pedagogy frameworks, and to seek to accommodate my own teaching to incorporate as many of the elements as possible. The New South Wales Quality Pedagogy model describes three principal domains of pedagogy: promoting intellectual quality, a quality learning environment and significance in what is being offered. Each domain is described in terms of six elements which are readily associated with good teaching practice and link directly to good learning on the part of our students.

Figure 1. The three dimensions of pedagogy in NSW schools (D.E.T., 2003b).

Promoting Intellectual Quality is seen as overarching in its importance. It aspires to deep knowledge and understanding, to a view of knowledge as problematic (rather than something to be transmitted in a static well-established form). Higher-order thinking is a necessary component, as is an explicit focus on the words and language being used (metalanguage). Teachers aiming for intellectual quality in their classrooms seek to promote substantive communication in order to achieve these goals.

The idea of creating a quality learning environment seems obvious to those seeking to understand requirements of good teaching practice. Achieving this, however, requires certain essential ingredients. Assessment assumes a leading role within models of quality pedagogy. No longer the “afterthought” of the planning process, but a very early and central consideration, it offers one of three central questions which need to be asked in planning for effective learning: What do I want them to learn? What are they going to do in order to learn? How will I know when they have achieved the goals I have set for their learning, and how well they have achieved them? Making your criteria explicit has long been recognised as a powerful incentive for learning, and few would disagree that engagement (both physical and cognitive) will form a vital part of any effective learning experience. High expectations are always associated with the best teachers, and with these come self-regulation and some measure of student direction in the learning process. Of course, any quality learning environment must be a socially supportive place, characterised by collaboration, positive reinforcement and shared responsibility for goal-setting.
If every teacher is a story teller, then the best teachers are those who work hard to ensure that their stories are worth telling. The **significance** of what is to be learned for the students has, perhaps, not been as strong a consideration in our domain of mathematics as it should have been. The familiar cry of “When are we ever going to use this?” still resonates in far too many classrooms. The best teachers are not just good communicators: they are *motivators* who recognise the primary importance of placing all learning within a context that is meaningful and relevant to their students. Quality learning values *background* and *cultural knowledge*, and treats knowledge as *integrated* not isolated. There is a prominent attention paid to the needs of all students through *inclusivity*. *Connectedness* both within the domain of study and to other domains and experiences is essential, especially for mathematics, which links and supports so many areas. Finally, the element of *narrative* may seem a little unusual among these other aspects of significance. But if students cannot tell the story of their learning, cannot relate it back in their own words and in an integrated and coherent way, then that learning has neither been deep nor significant. It is not only the teacher in any classroom who has stories to tell.

Every classroom, every learning experience, even each learning object, will satisfy some of these wonderful criteria to varying degrees. Neither is it claimed that these cover all possible elements of quality teaching and learning. They do, however, provide an excellent starting point by which to evaluate the quality of the experience for both teacher and learner. In particular, it is possible to use this framework as a lens by which to view these new technological tools for learning which are soon to be a part of all our classrooms.

**Gifts from a federal Santa Claus?**

Between 2001 and 2006, State and Federal governments across both Australia and New Zealand are jointly involved in a collaborative venture to produce hundreds of high quality digital online resources for use across the years of schooling and across identified key learning areas of priority (including literacy for students at risk, mathematics and numeracy, science, LOTE and others). These Learning Objects are being produced by the Le@rning Federation, the public face of this collaboration, and are subject to strict criteria in terms of content, production quality and pedagogy (Atkins, 2003; The Le@rning Federation, 2004a; The Le@rning Federation, 2004b).

“Specifically, learning objects are:

- Digital ‘pieces of learning material’ of limited file size and number of interfaces that meet a learning objective;
- Self-contained – each learning object can be used independently of other learning objects, or conversely, they can be aggregated – grouped together into larger collections of content to make a learning sequence;
- Reusable – a single learning object may be used in multiple contexts for multiple purposes i.e. across disciplines and Key Learning Areas;
- Tagged with metadata – for easy identification and referencing;
- Easily accessible through world wide web repositories/databanks”

(Chapuis, 2003, 4-4)

Some years ago when computers were new to schools and we were seeking ways in which to best make use of them for teaching and learning, one memory that remains is that of disks full of small programs and games. Even before the days of online access to what now seems an infinite storehouse of possible resources, the number and range of software tools seemed almost overwhelming. In what ways, then, will hundreds of learning objects for schools be different to those early pioneers of technological pedagogy?
Two particular differences are significant. The quality of early (and current online) software was extremely variable. There was no consistency of interface, purpose or suitability. Whether developed by amateur teachers or by more sophisticated programmers, there were few marriages of subject knowledge with pedagogy. Learning Objects claim to offer such a marriage.

The second significant difference lies in the use of metadata. A greater problem than even variable quality lay in identifying and accessing what was available on the many disks full of software, and linking this to your classroom needs. Learning Objects are made to be interrogated. Inbuilt in each is carefully chosen information (metadata) which allows them to be searched across a range of criteria. While the prospect of hundreds (even thousands) of new teaching resources may inspire concern rather than joy for many, the ability to search and retrieve suitable resources for particular content areas, applications or pedagogical principles is extremely encouraging.

Examples of learning objects

As suggested above, Learning Objects will support a range of Key Learning Areas in a rich and integrated way. Catch the Thief offers an imaginative scenario with a variety of inputs and strategies by which students may move towards a well-defined goal. While identified as a resource for literacy, it offers excellent cross-curricular potential, including possible links to forensic science.

In terms of Significance, it is potentially high on all elements. Student background knowledge is valued; the context is inclusive, integrated and connected, and strong elements of narrative are present. Opportunities to build cultural knowledge have been deliberately included where possible: the remaining paintings in the Art Gallery are identified by artist, title and other relevant information, which may supply a springboard for further study.

Each Learning Objects offers strong support for promotion of a quality learning environment. Although not explicitly serving an assessment purpose, each makes explicit the expectations of the task and the criteria by which success may be achieved. Expectations are high for all students, while providing avenues for a wide range of possible levels of outcome. The nature of the Objects is likely to prove highly engaging for many students, and each promotes self-regulation and student direction.
The achievement of *Intellectual Quality* criteria, however, for the most part remains in the hands of the teacher. Whether deep knowledge and understanding and higher-order thinking are achieved will certainly depend on the way in which the Object is used within the learning situation. As with any teaching resource, engagement does not guarantee learning. It remains the prime responsibility of the teacher to make explicit the links between the *physical* (What are they going to DO?) and the *cognitive* (What are they going to LEARN by doing this?) Well-designed technology, of course, can greatly assist in this transition process by explicitly linking the concrete to the cognitive. In the case above, students are required to use written language to progress through the activity; a physical simulation would equally reward spoken language and so not engage students in the higher cognitive demands required.

Figure 3. Where does speeding get you? [Science].
The enormous variety of Learning Objects available will be of great assistance in meeting curricular needs across a range of disciplines. As always, the possibilities for integration and cross-curricular connection will remain the responsibility of teachers and be limited by the capacity of teachers to “think outside the square”. The design and “searchability” of the Objects should serve to encourage such connections to be made and suggest possibilities for those with an open mind. Examples such as *Catch the Thief* and *Where does Speeding Get You?* are typical of the rich and integrated “game-scenario” objects available. Student control, physical involvement, competition and context all work to guarantee that this will be a popular activity (especially for boys?) but links to the “big ideas” of calculus and rates of change may not be obvious to teachers looking for explicit content connections.

Unfortunately, the majority of mathematics objects released to date appear strongly content driven. The few cross-curricular, integrated “rich tasks” are far outnumbered by specific-purpose activities designed to develop and consolidate understanding and skills of particular content areas, especially rational numbers. Granted that this remains an area of need – effective means of teaching those “difficult” areas – but it would be hoped that the nature and design of these Learning Objects will work towards a necessary shift in emphasis away from content and onto process as a means of increasing the relevance and transferability of mathematics learning.

![Figure 4](image.png) What’s in a Cube? [Mathematics]

![Figure 5](image.png) Take-Away Bar [Mathematics]

Certainly, rich mathematical objects are to be found, and all will satisfy particular needs, but there remains an element of contrivance in many of these which leaves a feeling of disappointment. Perhaps it is my expectations that are unreasonable, and my vague unease unjustified?
Learning objects from another perspective

In attempting to identify the origin of my unease, I looked away from the formal Learning Objects produced by the Le@rning Federation and considered other forms already in existence. There is a danger, of course, that almost anything could be termed a “learning object” and the tag could become meaningless. I was careful, then to limit my consideration to digital (computer-based) scenarios which fulfill a particular learning objective in a rich and integrated way. I did not have to look very far.

Some very compelling software learning experiences have been developed at the University of Wollongong in recent years (and the focus there remains firmly on such development). *Investigating Lake Iluka* (and *Exploring the Nardoo*) remain excellent examples of an integration of technology with real-world experiences. The computer-based scenario links explicitly with carefully-crafted practical engagement on several levels. I realised that one part of my unease arose from the tendency of many of the Objects to engage the students entirely within the computer microworld, without the need to engage actively with the real world.

![Image](image1.png)

Figure 6. Investigating Lake Iluka (Interactive Multimedia Unit, 1993).

The concept of microworld took me back to perhaps the first (and possibly still the most potentially powerful) Learning Object: the *LOGO* microworld created by Seymour Papert (Papert, 1980). A significant part of the success of this learning object remains the links it offers between technology and physical involvement of the learner. The same links are now available in another learning object, freely available for mathematics teaching and learning: the *SimCalc MathWorlds* project, directed by Jim Kaput from the University of Massachusetts (Kaput, 2003). This project sets as a major goal the “democratising of education” and is based upon two powerful premises: that mathematics should be *about something* and that the “big ideas” of mathematics can be made accessible from an early age through appropriate use of technology and physical involvement! Students learning in such an environment physically manipulate graphs to control the movement of animated actors, but can themselves enter the action using calculator-based motion detectors. Further, the software may now be used collaboratively across a group or class of students through a wireless classroom network system. Students may create their own motions in response to tasks and ideas set by teacher or other students, then share these motions with their peers, building entire classroom animated “marching bands” and class races, all linked to the “big ideas” of graphical representation, calculus and functions.
Conclusion

My vision for excellence in mathematics teaching and learning, then, must certainly involve the appropriate use of technology and, without doubt, will involve Learning Objects of many types. Our challenge as teachers, of course, remains to use our knowledge of our subject matter, our skills of pedagogy, our own wisdom of practice and, above all, our concern for and knowledge of our own students to create the most effective and appropriate learning experiences we can, using those tools most suitable for that task. I have little doubt that Learning Objects will be less of a solution than carefully structured learning sequences. The very notion of “object” suggests use in isolation, as a filler or even a “quick fix”. While Governments are proving happy to deliver large numbers of these extraordinary and powerful tools, the real challenge for teachers will lie perhaps in building an accompanying database of lesson plans and sequences which describe effective classroom trials and applications of these resources.

So, as teachers, let us embrace the possibilities of these wonderful tools, but do so mindful of the demands of quality pedagogy, and the limitations of any computer-bound learning resource. For all their fizz and whistle, their colour and movement, their compelling contexts and extraordinary scenarios, Learning Objects need to be viewed in the context of a rich variety of learning experiences, and serve simply to add another element to an already rich pedagogical repertoire now available to us all.

References

The Le@rning Federation. (2004a). Quality assurance framework for online content development. Melbourne: Curriculum Corporation and education.au limited.