

Pedagogy, Innovation and e-Learning in Primary Schools

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Over 400 e-learning grant applications from Australian primary schools were analysed to determine the nature of the proposed ICT-based projects in Literacy and Numeracy. Three key dimensions emerged from the teacher descriptions: ICT Infrastructure, Motivation and ICT Use, and Pedagogy and Innovation. The three dimensions, and the interactions between the dimensions, provide a means for understanding the complex factors within an individual school that determine the nature of ICT use and the potential for innovation. This paper focuses on the types of pedagogy identified and the nature of the innovation in these schools. The majority of schools (73%) described their innovative e-learning projects and approaches to teaching and learning with the view that ICT is a pedagogical tool for improving learning outcomes in Literacy and/or Numeracy. In 14% of the schools teachers described using technology in more innovative ways and exploring new pedagogical approaches that in turn, create new learning environments.

Access to Information and Communication Technologies (ICT) in primary schools throughout Australia has substantially increased over recent years and there is evidence of growth in its use by teachers and students (Levin, Stephens, Kirshstein, & Birman, 1998). However, compared with the impact on the rest of society, the advent of computers and the Internet has not dramatically changed how teachers teach and how students learn in schools (Downes, Fluck, Gibbons, Leonard, Matthews, Oliver, Vickers, Williams, 2001; Meredyth, Russell, Blackwood, Thomas & Wise, 1999). The reasons for the overall lack of integration of e-learning into our schools are a complex mixture of the level of access to ICT, teacher motivation and the relationship between the available technologies and pedagogy. Given the pressure from federal government policy (*Backing Australia's Ability: An Innovation Action Plan For The Future*, Australian Government, 2001), the high levels of investment in ICT at the state and territory level and the significance of ICT in modern economies, understanding the factors that inhibit the use of ICT in classrooms is critical for both educators and policy makers.

Pedagogy and ICT

Pedagogy embodies knowledge and skills, classroom management, and overall effective teaching practices. It is a complex blend of professional knowledge and practitioner skills (Lovat, for Australian Council of Deans of Education, 2003). A teacher's own pedagogical beliefs and values play an important part in shaping technology-mediated learning opportunities. The research literature suggests this may result in technology being used as either a 'servant' to reinforce existing teaching approaches, or as a 'partner' to change the way teachers and pupils interact with each other and with the tasks (BECTA, 2004).

A growing body of research (for example; Barker, 1999; Goodyer, 1999; Hannifin, 1999; Hayes, Schuck, Segal, Dwyer & McEwen, 2001) identifies the potential of computer-based technologies to transform pedagogy in the following ways:

- a shift from 'instructivist' to constructivist education philosophies;
- a move from teacher-centred to student-centred learning activities;
- a shift from a focus on local resources to global resources; and
- an increased complexity of tasks and use of multi-modal information.

Innovation and ICT

Innovation is the act of departing from the traditional. It is the process of making changes to something established by introducing something new. Both internal and external forces drive the need for schools to change and to innovate in order to change (Yee, 1998). In educational settings, external forces may be the need to update practices in keeping with the findings of international research, and to continually conform to national trends and even community expectations. Internal forces may be the pressures created by curriculum reform, the desire to improve student outcomes (either as a whole or particular groups of students) or in response to the collective or individual values of teachers.

The educational model of innovation frames innovation, in the broadest sense, as “an idea, practice or object that is perceived as new by an individual or other unit of adoption” (Rogers, 1995, p.1). Accordingly, the educational model of innovation focuses on the idea of the ‘new’: new learning objects, new ways of teaching, and the creation of new learning environments.

While ICT, in various forms, have been used in schools for more than 20 years the recent rapid increase in their density, combined with access to the Internet, has constructed them as new learning objects. In an educational model, innovation is framed by the adoption and diffusion of technologies as new learning objects within educational institutions (Dooley, 1999). In this context innovation may simply mean the utilisation of technologies (new objects) not previously used so that the new learning object, the technology, becomes the innovation (Robertson, 2000; Connell, 2000). In order to use the ‘new’ technologies an emphasis is placed upon the teaching and learning of skills deemed necessary to use the technologies.

Alternatively, a new learning object may be the provision of traditional curriculum tasks via new technologies, that is, technology as a tool (Casey, 2000). The new objects become teaching and learning tasks that utilise technologies in order to enhance existing curriculum outcomes. The outcomes are achieved because of attributes inherent in the technologies, increased student motivation (Fluck, 2001; Russell, Mackay & Jane, 2003) or a combination of the two.

The Study

In national Literary and Numeracy Week 2002, the Commonwealth Bank launched the e-Learning Grants program to provide funding for projects in Australian primary schools. A major criterion for awarding a grant was that the project had to ‘add value to’ or enhance existing practices. This enabled schools that were only just beginning to embrace e-learning to compete with schools in more advantaged situations. In the first year of this initiative, applications were received from thirteen hundred primary schools from Government, Catholic and Independent sectors. These 1300 schools represented almost 20% (19.4%) of all primary schools in Australia. Four hundred and sixty four (464) schools provided written consent for their applications to be used for research purposes and this study focuses on the data from these schools only. The sample schools represent 36% of the total number of schools who applied and almost 6% (0.058%) of the primary schools in Australia in 2002 (*The National Report on Schooling in Australia, 2001*, MCEETYA, 2002). Overall, the sample generally reflected the percentage of schools from each state and territory and each of the education sectors (Table 1). Victoria was slightly over-represented and NSW slightly under-represented in the sample.

Table 1: Percentage of schools in study compared with actual percentage of Australian schools

<i>State/Territory</i>	<i>Percentage of Sample</i>	<i>Actual %of Schools</i>	<i>% Difference</i>
NSW n= 155	25.3	33.0	-7.7
VIC n= 155	33.5	25.0	+8.5
ACT n= 118	4.8	1.0	+3.8
NT n= 7	1.5	2.0	-0.5
TAS n= 10	2.2	3.0	-0.8
WA n= 36	7.6	10.0	-2.4
SA n= 41	8.9	8.0	+0.9
QLD n= 75	16.2	18.0	-1.8

In their e-Learning Grants applications, schools were asked to provide some basic statistical information about the school (education sector, state, student population etc), a description of their project outlining why they felt that their project was innovative, information about their current use of ICT, their motivation for their project, expected outcomes with a particular emphasis on literacy and/or numeracy, a proposed budget and an overview of the people involved.

The researchers adopted the theoretical perspective of grounded theory (Strauss and Corbin, 1998; Denzin and Lincoln, 2003) to develop a framework for understanding the essence of the information provided by the teachers. Initially, 70 applications were reviewed as a ‘pilot’ study and from this a database shell was developed. Some of the data fields were further examined using ‘content analysis’ processes to determine the incidence of phenomena (categories of description) embedded within the text.

Three consistent themes or dimensions emerged during the pilot phase, which essentially described the ‘what’, ‘why’ and ‘how’ of innovative ICT use by schools in the context of their proposed projects. These dimensions, with their sub-categories (types or levels), were tested against current policy and research literature, refined accordingly and then applied to the detailed analysis of each application. Each of the 464 applications was individually examined, categories and coding created and the data manually entered into the appropriate fields in the database.

Findings

A three dimensional framework consisting of ‘ICT Infrastructure’, ‘Motivation and ICT Use’ and ‘Innovation and Pedagogy’, and three or four corresponding sub-categories, was identified (Table 2). The vertical alignment of the ‘Types’ in Table 2 is deliberate as strong relationships between the levels within each dimension were found (Webb, Way & Brooke, 2005).

The focus of this paper is the dimension of Pedagogy and Innovation and the following section explains its components. The grant application sections that predominately contributed information to this dimension were descriptive of existing or proposed teaching practices, therefore can be considered to be strong in ‘teacher voice’. Quotations from the applications are provided for the reader to ‘hear the teacher voice’ directly.

Table 2: The three-dimensional framework

Dimension	Type 1	Type 2	Type 3	Type 4
ICT Infrastructure	Disconnected environment	Initially connected environment	Established connected environment	Multifaceted connected environment
Motivation and ICT Use	Situational – Reactive	Skills Oriented	Proactive – Higher Order	
Pedagogy and Innovation	ICT as an Innovative Object	ICT as a Curriculum Tool	New Learning Environment	

Pedagogy and Innovation Type 1: ICT as Innovative Objects

Type 1 teachers focussed on the newness of the technologies, what the technologies could do and how they could be used in classrooms. Schools of this type are in the initial stages of understanding the technologies and their capabilities. Type 1 teachers are innovative because they are making use of ICTs that have never been used in their classrooms before. Some Type 1 schools described themselves as ‘disadvantaged’ frequently in terms that described their lack of access to ICT. The ‘newness’ of the technologies associated infrastructure reflected this disadvantage.

Type 1 project descriptions include references to factors such as:

- Computer labs;
- Basic skills in Literacy and Numeracy;
- Core IT skills (word processing);
- Increasing confidence and ICT experience;
- Raising expectations;
- Efficiency of organization, time, access to information, planning; and
- Motivation of reluctant learners.

This type is evident in the following quotations from applications:

Being at the infancy stage of introducing E-learning, we saw the potential that a grant of this size could assist us in the implementation of our program. Like most Independent schools in the country, we struggle to keep up financially with the demands of setting up and maintaining a program such as this. (Victorian Independent School)

A small group of male students their literacy and numeracy skills are poor and they are in danger of falling further behind. Recent research demonstrates the potential for the use of e-mail and website publishing as being excellent motivators for students especially those whose literacy levels are not developing using more traditional approaches. (NSW Government School)

We have established a dedicated Computer Laboratory and employed a technology teacher. This teacher takes classes of students to both develop and apply their computer skills. Classroom teachers access the laboratory computers with their students on a rostered basis for the remaining time. (Western Australian Catholic School)

Pedagogy and Innovation Type 2: ICT as a Curriculum Tool

Type 2 teachers have evaluated the utility of ICT in the context of improving student outcomes within Key Learning Areas. ICTs are used because they can make teaching and learning more efficient. Teachers use their knowledge of curriculum content to interrogate

the value of any technology and integrate the technologies into the curriculum and classroom practice according to their perceived value. Type 2 schools have had experience in using ICT but they have a directed focus on achieving student outcomes. A large number of schools proposed using ICT to support the learning of children with special needs.

The project descriptions in this category emphasise factors such as:

- Learning opportunities provided through the use of ICT;
- Curriculum delivery enhancement;
- ICT as an educational tool, powerful tool, information tool, productivity tool, support tool, tool to enhance learning;
- Integrating ICT across learning areas;
- Online units of study;
- Designing rich learning resources;
- A tool for assessment; and
- The development of descriptors for competencies, achievement and curriculum outcomes.

The following quotations from applications provide examples of this type:

Using information and communication technologies as a tool, the teachers are able to assist children having difficulty to meet particular Mathematical outcomes as well as giving all students an opportunity to gain more practice and assistance from computer programs. (Victorian Catholic School)

With the use of the computer lab as a teaching tool for finding and using information, and also used for communication, each child at every level should achieve these outcomes for English. (NSW Government School)

These groups are already involved in individual and small group work using the computer as a tool for the development of Language and Speech delays. (Western Australian Independent School)

Pedagogy and Innovation Type 3: New Learning Environment

For Type 3 teachers there has been some history of ICT use. Type 3 teachers are exploring the ‘newness’ of the environment created by the technologies. They are challenged not by the technologies, because the teachers are aware of their potential, but by the impact they have had on how teachers perceive their own role, how classrooms can be organized and the relationships that develop within them, and how new learning tasks/experiences can be structured. The technologies themselves may be used as a tool to organize ideas (such as mind mapping software), to search for current information (using the Internet), to present ideas (using word processing, desk top publishing or web page editors or multi-media software such as PowerPoint) or, to create animations or movies. Computers are generally dispersed around the school or in portable form.

Type 3 project descriptions feature factors such as:

- Meaningful and relevant learning strategies;
- Learning styles or multiple intelligences,
- Inquiry oriented online tools;
- Collaboration and co-operation; and
- New ways of learning, personalised, realistic, self-paced, self-directed, non-linear, self-assessed.

Learning environments are described as:

- Virtual;

- Real-time synchronous;
- Geographically remote,
- Collaborative,
- Networked;
- Global;
- Communities; and
- E-learning spaces.

An example of one school's description of pedagogy:

Our emphasis is now 'shifting' to how ICT can be used to enhance student learning in ways which wouldn't otherwise be possible. The staff has begun to consider ways in which the Internet, Multimedia, mind mapping, desktop publishing and word processing programmes can be used to allow students to:

- actively participate in their learning
- develop critical thinking skills
- use different learning styles
- develop their questioning, thinking and problem solving skills
- improve their communication skills
- work collaboratively
- develop creative and presentation skills
- develop a more global perspective on topics.

(South Australian Government School)

A National Picture of Pedagogy and Innovation

The majority of schools (73%) described their innovative e-learning projects and approaches to teaching and learning with the view that ICT is a pedagogical tool for improving learning outcomes in Literacy and/or Numeracy (Type 2: ICT as a Curriculum Tool). Only 13% characterised ICT as itself being the innovation (Type 1: ICT as an Innovative Object), and 14% expressed the idea that ICT enables new or creative learning environments and thus new ways of teaching and learning (Type 3: New Learning Environment). (See Figure 1)

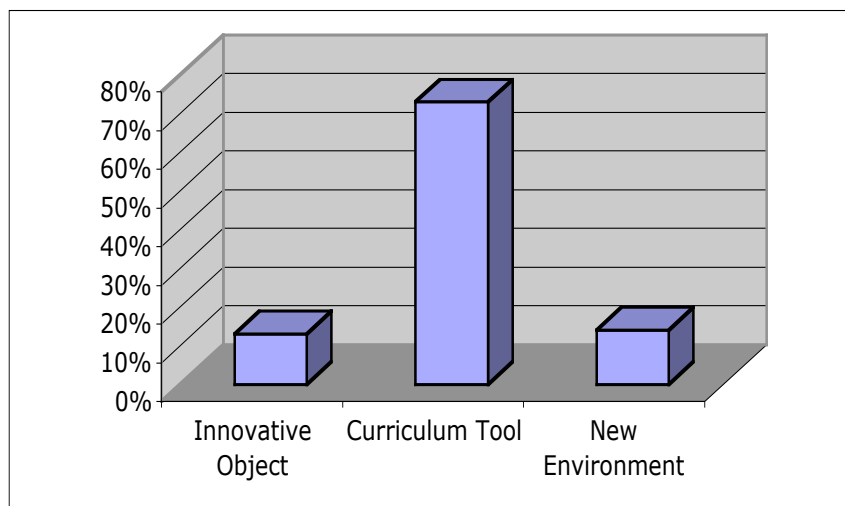


Figure 1: Types of pedagogy and innovation across Australia

The predominance of ‘Type 2: ICT as a Curriculum Tool’ (73%) suggests that the ‘typical’ primary school in Australia views technology as a teaching and learning tool for improving curriculum outcomes. The projects described deliberate uses of ICT to enhance student outcomes; the technologies were being used because they were perceived to bring greater efficiencies to teaching and learning. While the resources are new and exciting, the learning goals and pedagogy are essentially the same as without the technology.

For 13% of the schools in 2002, ICTs were a still ‘new’ phenomenon in the school (Type 1), while 14% of the schools had experienced ICT long enough to perceive the technologies as having an impact on the way in which the learning environment itself was constructed. For Type 3 schools the technologies are potentially creating ‘new’ schools and learning environments.

Although nationally there is a clear centring on ‘Type 2: ICT as a Curriculum Tool’, there were some different tendencies when states/territories were separated (Table 3 and Figure 2). NSW schools had a slight leaning towards ‘Type 1: ICT as an Innovative Object’, while Victoria and the ACT had a stronger tendency towards ‘Type 3: New Learning Environment’ than the other states. Queensland and South Australia had above the national average percentage in the two extremes of Type 1 and Type 3. When considering the Northern Territory’s 100% placement in Type 2 it must be noted that only seven schools were represented.

Table 3: Pedagogy and innovation types across states and territories

State/Territory	Type 1 Innovative Object	Type 2 Curriculum Tool	Type 3 New Learning
ACT	4%	78%	17%
NSW	18%	73%	9%
NT	0%	100%	0%
QLD	17%	57%	26%
SA	15%	68%	17%
TAS	9%	91%	0%
VIC	11%	74%	15%
WA	5%	87%	8%

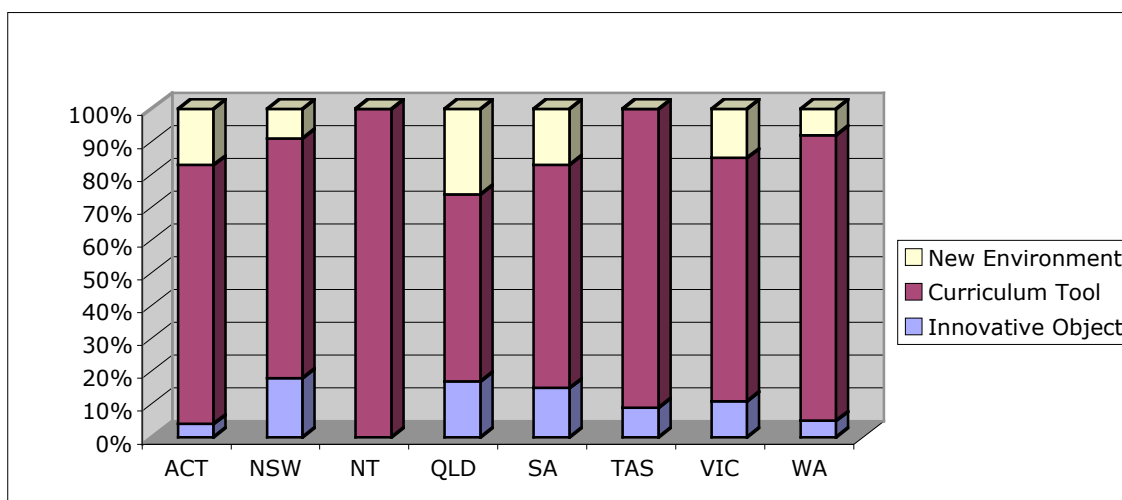


Figure 2: Pedagogy and innovation types across states and territories

Pedagogy & Teaching Strategies

While many of the e-learning grant applications from schools identified as Type 2: ICT as a Curriculum Tool' mentioned specific pedagogies associated e-learning, the explanation of changes in pedagogy and the creation of new learning environments was a particular feature of Type 3: New Learning Environment.

The following section presents the teaching strategies mentioned by teachers who believe that the strategies can be applied in technology-rich learning environments where the focus is not primarily on the technologies being used, but on the learning experience and what students learn as a result of the experience. Some brief background information on each teaching strategy is followed by quotations to give the teachers' own choice of words for describing their school's perspective. It was common for teachers to describe a combination of teaching methods.

Constructivism

Although there is no single definition of constructivism, the influence of constructivism in education is evident in outcomes-based curricula now used in most states and territories. The constructivist view of learning holds that the learner is an active participant in the learning process, with each learner interpreting experiences and connecting concepts and understandings in his/her unique way. This view underpins a range of student-centred teaching practices in Australian classrooms. The use of open-ended tasks and rich learning tasks is often a feature of such an approach because this allows multiple outcomes and levels of progress.

Our e-learning initiative compliments constructivist learning theories describes in the SACSA Framework. Especially as a part of student initiated curriculum our students are supported to choose key ideas from SACSA to plan learning challenges." (South Australian Government School)

We believe this project will enhance student learning by taking them from their own knowledge base and using the constructivist theory extend them to make sense of the large world... Students will evaluate and record their learning using the technologies of multimedia. For example, it is much more explicit to capture concepts like measurement and patterning using photos and video. (South Australian Government School)

Co-operative and Collaborative Learning

Cooperative learning is defined by a set of processes which help people interact together in order to accomplish a specific goal or develop an end product which is usually context specific. The underlying premise of collaborative learning is based upon consensus building, through cooperation by group members. Cooperative learning is more directive than a collaborative learning and is closely controlled by the teacher (Panitz, 1996). In cooperative and collaborative learning students generally work together in groups of two or more. These are usually face-to-face groups but, with the rapid expansion and availability of ICT such as e-mail, this can also be undertaken effectively at a distance.

“Because our students are encouraged to initiate, negotiate, organise and manage their learning choices, and work collaboratively on open-ended activities, they challenge themselves intellectually and practice important life skills while achieving much broader learning outcomes - the sky's the limit!” (ACT Government School)

Thinking Skills and Higher Order Thinking

A thinking skills framework commonly used in schools is the de Bono's Six Thinking Hats (2000). This approach promotes the deliberate and proactive use of various modes of thinking to process any topic, problem or experience with the purpose of developing a broader understanding and appreciation. The types of thinking include judgement and caution, intuitive and emotive responses, creativity, consideration of processes, logical and meta-cognition (thinking about thinking).

'Multiple Intelligences', De Bonos Thinking Hats and Blooms Taxonomy inform our curriculum development. Our curriculum is based on an integrated model (using inquiry-based learning as one tool). Integration of ICT competencies and use of ICT equipment across all KLA's is fundamental to our approach. (ACT Government School)

The Taxonomy of Educational Objectives (known as Bloom's Taxonomy) was created in the 1950's as a means of expressing qualitatively different kinds of thinking (Bloom & Krathwohl, 1956). The hierarchy describing the cognitive domain of the taxonomy is familiar to most teachers and can be used when planning a series of learning experiences for students, particularly when trying to encourage higher order thinking. The levels are: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.

In the last 18 months the school has moved from a predominantly skills based Information and Communication Technologies focus to a program focus based on higher order uses of ICT featuring enhanced linkages to teaching and learning programs ... (NSW Government School)

Learning Styles and Multiple Intelligences

Litinger & Osif describe learning styles as “the different ways in which children and adults think and learn” (1992, p.73). Learning styles refer to the ways people acquire, process, and apply new information. Teachers who accommodate differences in learning styles try to identify these different learning styles in their students in order to match teaching style with learning style. The relatively new view of the learning process provided by learning style research has encouraged many teachers to explore how some of the possibilities created by ICT can match students' learning styles.

Our e-learning initiative will provide resources to engage students with a range of learning styles, backgrounds and interests. Significantly, our e-learning initiative includes the use of world-standard technologies and applications (Eg: Adobe Photoshop and Adobe Premiere) rather than 'sit and click' type products. We recognize the ability of students (of all ages) to successfully use world-standard applications for a real purpose and strive to provide consequent time and resource opportunities in our teaching practice. (South Australian Government School)

E-Learning is a very powerful method of presentation as it involves, visual, auditory and kinaesthetic aspects whilst allowing students and teachers to interact not just in the classroom but at any time via

email, and the VPN. We have seen that learning is enhanced when there is a high level of self-motivation and self-reliance, which this form of delivery encourages. (South Australian Independent School)

Multiple Intelligence theory states that there are at least seven different ways of learning anything, and therefore there are seven intelligences: body/kinaesthetic, interpersonal, intrapersonal, logical/mathematical, musical/rhythmic, verbal/linguistic and visual/spatial (Gardner, Kornhaber, & Wake, 1996). Using this approach in the classroom usually involves teachers providing opportunities for children to use and develop a range of intelligences.

The theory and practice of Gardner's Multiple Intelligences and Lane Clark, a Canadian educator who developed programs for student learning environments, encourage the self selection of tools when children respond to a new learning environment. Our multimedia learning will empower staff and students to think in new ways and extend the boundaries of ICT use, which will in turn extend their knowledge and skills. Our E-Learning initiative aims to further encourage and connect the use of ICT in everyday learning. (Victorian Government School)

Inquiry Based Approaches and Rich Tasks

Inquiry-based learning is not a well-defined term, but the various approaches share some common beliefs. It is a student-centred, active learning approach focusing on questioning, critical thinking, and problem-solving. Inquiry learning has its theoretical foundations in constructivism. In inquiry based approaches learning is an active process that is enhanced by engaging in interaction with others working on the same problem (hence its association with collaborative and co-operative learning), where language is the most important carrier of these inquiry-supporting interactions (Nickerson, 1988; Rubin, 1996).

Inquiry based approaches are usually characterised by the learners being actively engaged in exploring an 'integrated topic' through a series of processes that challenge their thinking and support them in making connections within and between existing and new understandings. The inquiry typically culminates in the student taking some form of positive action and so impacts on values as well as skills and understandings.

.....aims to provide an innovative and dynamic learning environment where e-learning is an integral part of the teaching and learning program. Our goal is to provide present and future students with the information and communication technology skills they will require as active, responsible, resilient and environmentally aware citizens in an ever changing, knowledge based society. ...We believe that the cultural, academic and social needs of children and the wider school community will be enhanced through collaborative e-learning experiences. Through provision of ongoing, exciting, engaging, empowering e-learning professional development, teachers will maximise significant learning improvements for both students and themselves. (Victorian Government School).

Rich learning tasks are learning experiences that integrate understandings/competencies from a number of disciplines in order to complete or resolve a problem and opens up opportunities for action rather than directs students down a prescribed pathway. Such an activity "implies the active involvement of the learner in making choices about what experiences to undertake" (Muirhead & Haughey, 2003, p.15).

A further area of focus has been the development of learning programs that involve high levels of literacy and higher order thinking. This program involves development of "Rich Tasks". These Rich Tasks incorporate the use of technology to access information, using critical literacy to explore knowledge and incorporate the use of multimedia tools (digital video etc) in the publication and presentation of this knowledge. Our motivation is to marry these two priorities. (NSW Government School)

Project based learning

Project based learning (PBL) is an approach to learning that focuses on developing a product, creation or artefact. PBL uses complex, real-life (authentic) projects to motivate learning. Students are more autonomous as they construct personally meaningful products or

artefacts that are representations of their learning. PBL shifts away from the classroom practices of short, isolated, teacher-centred lessons and instead emphasizes learning activities that are long-term, interdisciplinary, and student-centred. The approach is also inquiry-based when students are active in creating the problem. The introduction of ICT in schools has provided an enormous number of possible projects for students in primary schools.

The effective integration of Learning Technologies into a learner centred environment will offer students fundamentally different learning experiences that may surpass those of other mediums and which seek to validate learners' ideas in the realm of the real world.....We view technology as one of the many tools available for teachers to expand, modify and manage learning experiences, in order to provide all students with authentic and relevant opportunities for development and growth. (Victorian Government School)

The need for educators to provide opportunities for students to develop skills in analysing and problem solving, communicating ideas and information, planning and organising and collaborating with others.....need to develop 21st century skills of online collaboration and Internet research skills that developed a global network of students that encourages them to think critically.....The challenge of integrating technology into our learning and teaching. (NSW Catholic School)

Multi-literacies and Critical Literacy

In the modern digital communications environment of computers, multimedia and the Internet, and in accordance with an increased awareness of cultural contexts, the notion of 'literacy' has been redefined to encompass the 'multimodal' skills of linguistic, visual, audio, gestural and spatial 'meaning-making' (Bigum & Lankshear, 1997; New London Group, 2000; Healy, 2000). The availability of vast amounts of information originating from diverse perspectives and contexts has made the development of the capacity for critical reflection in students imperative (Lankshear, Snyder & Green, 2000; Unsworth, 2001). These 'new literacies' have required a shift in pedagogy that impacts across the curriculum, not only on the area of English Literacy. Aspects of multi-literacies and critical literacy are already imbedded in state curriculum and ICT documents and schools are increasingly seeking opportunities for involvement in ICT-based projects that promote the development of such skills in their students.

... students will only become truly literate in this multimedia multicultural society if they are allowed to be actively involved in the design and construction of knowledge representations using hypermedia / multimedia tools." (Queensland Government School)

Call them 'New' Literacies or 'digital' Literacies, students still need to comprehend and analyse what they read, they still need to evaluate in order to extract and organise information and they still need to synthesise information in order to reconstruct." (Queensland Independent School)

Discussion

The teaching practices employed by teachers reflect their personal values and educational philosophies. Using technology effectively in classrooms involves teachers in a process where their values are often challenged. To use ICT teachers need to learn how to use specific hardware/software. To use ICT in their classroom practice teachers need to evaluate their approaches to teaching (pedagogy) and the values embodied in these approaches (BECTA, 2004). If the dominant pedagogy in a school involves whole class teaching and is based on a transmission approach a small number of computers in classrooms can represent a conflict in values. Alternatively, a computer lab will be consistent with and reinforce the values and pedagogy associated with whole class teaching. The increase in the use of computer labs noted in the sample is consistent with the use of specialist teachers, such as computer/technology teachers in primary schools. Ravitz, Becker and Wong (2000) found that such specialist teachers were far more likely than general classroom teachers to

adopt traditional transmission approaches than to focus on critical thinking and sense making. The language used in most of the applications suggests that teachers are influenced by constructivist philosophies. The use of specialist teachers and dedicated computer classrooms in many primary schools suggests that a conflict in values may exist in some schools.

The majority of teachers are still in the process of adopting ICT as a regular teaching tool and are motivated by the immediate learning needs of their students. However, in some schools, the increasing density of dispersed, networked computers in primary schools has challenged the values of teachers and is prompting a re-conceptualisation of their role and of approaches to teaching and learning.

As teachers' experiences with digital technology projects are increasingly documented, educators' understanding of the characteristics of suitable pedagogy is building. Effective teaching and the successful integration of ICT in classrooms rely on sound pedagogical frameworks. Common to all of the pedagogical approaches and teaching strategies described above is the emphasis on the creation of student-centred learning environments with students taking greater responsibility for their own learning, the need for authenticity grounded in the student's experience, and integrated 'cross-curricular' tasks that involve intellectual quality, critical thinking skills and reflection. This is consistent with other research, such as Carr's (2002) study of the large national project *Netdays Australia* which described the successful implementation of online curriculum projects in the classrooms of 60 teachers.

Conclusion

This study has found that, irrespective of the level of technological infrastructure that exists in an individual school, teachers believe that they have the potential to develop innovative projects. The innovation may be in the use of a new technology, using a technology in a new way within the curriculum or using the technologies to assist in the creation of new learning environments.

While ICTs are regarded as new objects, whether they are a computer in a classroom, a computer connected to the Internet, the creation of an Intranet, digital cameras, data projectors or multimedia and digital video, teachers need significant time to initially develop their skills and confidence in using the technology. Teachers who have positive attitudes towards ICT are likely to have well-developed ICT skills and to see ICT as an important tool for learning and instruction (Mosely, 1999). They are also likely to use constructivist pedagogies, value collaborative working, enquiry and decision-making by pupils. Teachers who have reservations about using ICT are likely either to exercise a higher degree of direction or to prefer pupils to work individually (Mosely, 1999). Whatever the technologies, the evidence contained in the teacher descriptions suggests that they will initially focus on the technology as a new object and the skills necessary to use the object. Innovation within this context is framed by the technologies and the skills required by teachers and students to use the 'new' objects in the classroom.

By far the majority of schools describe how ICT were to be used within or across the curriculum; as a 'curriculum tool' to achieve/enhance student outcomes. New technological objects are incorporated into the existing curriculum and often into existing pedagogies. The technologies are a means of enhancing existing practices or increasing their efficiency. The creation of specialist facilities and the use of specialist teachers may, inadvertently, impede the full integration of ICT in primary classrooms and reinforce pedagogies that are inconsistent with constructivist classrooms. While teacher efforts to integrate ICT within

existing pedagogical practice have been limited (Becker, 2000; Elliott, 1999; Downes 2002), this study suggests that the use of ICT as a curriculum tool is a stage most schools will enter.

The greatest influence of teaching style appears to be the organizational culture of the school (Di Benedetto, 2005). In order for ICT to be successfully implemented, teacher beliefs and values need to be shaped and supported by the organisational culture of the school (Dexter, Anderson, & Becker, 1999). That a small percentage of schools describe innovation in terms that suggest they are creating 'new learning environments' suggests that where the organisational culture of a school provides the time and opportunity, to reflect and consider new uses for the technologies and new teaching approaches, significant changes in the learning environment are considered.

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