ICT and learning: Lessons from Australian classrooms

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Abstract

Research into Information and Communication Technologies (ICT) in schools is well into its third decade but there is still a pressing need to better understand how computer-based technologies are influencing learning opportunities, and how the local conditions of schooling impact on teachers’ attempts to integrate these technologies in their classrooms. In this article, we provide some insight into these questions through our research in six diverse public schools in the state of New South Wales (NSW), Australia. We observed classrooms and conducted interviews with teachers and other key stakeholders, such as principals and technology coordinators about the integration of ICT. Our goal was to describe and examine the ways in which teachers, in a range of settings, are utilising ICT in their classroom practices to mediate student’s learning experiences. Our findings indicate that ICT is largely being integrated in ways that support and supplement existing classroom practices. From our observations, we believe that successful integration of ICT requires fundamental shifts in the core activities of schools. These shifts include new teaching. The cases described in this article suggest some ways in which these shifts may be initiated and sustained.

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1. Introduction

Politicians, policy makers, school leaders, teachers and parents are starting to develop more critical understandings of the issues associated with integrating ICT in schools. This may be largely due to the high costs associated with supplying and maintaining these technologies, as well as the slow uptake of ICT by teachers. In NSW, the introduction of computers into public schools is a major Government priority that has received over $AU300m in funding in recent years, with a further $AU500m projected over the period 2003–2007. The NSW government’s Computers in Schools Plan aims to improve learning outcomes for all students in all key learning areas, from Kindergarten to Year 12. It involves a comprehensive program of support to schools that includes: the provision of regularly updated computer hardware and software; connection of all schools to the Internet; provision of training and development of teachers in the use of computers; and, the development of curriculum support materials to enhance curriculum in all Key Learning Areas. However, despite this commitment of money and support, the rate of uptake of ICT and the success of school-based practices varies enormously across the state.

The gradual emergence of a more critical understanding of the promise and pitfalls of ICT integration suggests that the climate is right to rethink some common assumptions and research questions related to this process in schools. Belatedly (for some), the question is being asked: What are the educational benefits of ICT integration? In an attempt to respond to this question, the research reported here was designed to prioritise questions related to learning over those related to technology. It was assumed that the most important factor affecting the quality of learning associated with ICT integration was the design of the learning experience. And, a close link was assumed between teachers pedagogical practices and the learning opportunities made available to students.

An emphasis on learning is supported elsewhere in the literature. In their review of the second decade of research into gender equity and information technology, Volman and Van Eck (2001) observe that:

*Recently, strong arguments have been put forward for the introduction of advanced ICT applications as a means of creating a powerful learning environment. This involves new forms of learning and teaching (transformation) in which students deal with knowledge in an active, self-directed and constructive way, leading to learning results that are more transferable to situations outside school than are the results of traditional teaching methods.* (p. 614)

Whilst the term ‘powerful learning environment’ is not commonly used in the literature, it has appeared in this journal (Smeets, 2005), and it has been the focus of a European research network (see for example, De Corte, Verschaffel, Entwhistle, & van Merrienboer, 2003). More generally, a quick search of most relevant databases reveals that questioning the basis for how learning occurs and is mediated through ICT is a trend that has gathered momentum in the last five years, while recognising that it has been a long-term interest of sociocultural theorists (see for example Renshaw, 1998) and other researchers whose primary interests relate to theories of learning (see for example Schaverien & Cosgrove, 1999).

The approach taken in this study was to look for evidence of transformations in learning opportunities through teachers’ classroom practices. As Moll (1997) concluded some time ago: technology alone will not necessarily improve the outcomes and processes of teaching. She also claimed that the need to integrate technology in the classroom is really tied to the greater plan of
introducing information technology in society in general. Therefore, she suggests that a responsible plan to introduce technology in the classroom should firstly agree on a definition of education and its goals and second, be based on how technology will affect and restructure the learning environment and process rather than on how good a teaching tool it is.

Following this suggestion, we were interested in whether teachers in diverse settings in our study were operating with a shared definition of education and its goals. This required us to locate our classroom observations within the broader context of schooling. Our approach included interviewing and observing teachers integrating ICT in their classrooms, and interviewing other key stakeholders. We identified some common issues across the schools, documented a range of integration strategies and collected various documents such as annual reports and technology plans. This multi-level data provided us with evidence about ICT integration and learning in the participating schools. It is a contextualised study that was set up to analyse in a few cases, rather than predict, what is actually happening, and what type of relations people are developing towards ICT.

2. Researching learning

Our research design draws upon qualitative methods to examine ways in which teachers in a range of schools were utilising ICT to mediate students’ learning experiences. During field trips to the each of the six participating schools, five to eight classrooms were visited. The difficulties associated with describing the complex activities that occur simultaneously in classrooms have long been noted, as have the attendant problems associated with interpreting what is taking place (Good & Brophy, 1973). For this reason, the researchers worked in pairs to complete classroom observations, and later checked their impressions with each other, and with the classroom teacher during extended interviews.

2.1. Participating schools

The schools were selected after preliminary visits and after discussions with a range of sources, including consultants, teachers and other researchers, who were of the opinion that concerted efforts were being made at each site to integrate ICT. Additionally, to ensure that different types of schools were represented in the study, indicators such as geographic location, school type and socio-economic status of the surrounding community were taken into consideration. Consequently, four of the schools received additional equity-based funding, one was located in a rural area and a number of school types were represented. A brief description of each school is listed in Table 1 (pseudonyms have been used).

2.2. Participants

Each school was asked to nominate teachers who were considered to be innovative and confident users of ICT in their classrooms. This meant that classrooms across a range of years and subjects, as well as teachers with a range of experiences were included in the study. Each classroom
<table>
<thead>
<tr>
<th>School name, Type</th>
<th>Features at the time of the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tall Timbers Primary School</td>
<td>This school incorporates the district’s physical support unit. It was beginning the second year of a 5-year technology plan. This involved a mentoring program organised around the completion of a whole school CDROM, to which each staff member and student were expected to contribute</td>
</tr>
<tr>
<td>236 North-western suburbs of Sydney in a high technology area</td>
<td></td>
</tr>
<tr>
<td>Egan Avenue Pre-school and Primary School</td>
<td>The school used additional equity-based funding to develop teachers skills with Microsoft Office applications using external consultants. A computer lab was established and each class attended the lab weekly to work through stage appropriate skills with the computer teacher</td>
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<tr>
<td>423 Outer western suburbs of Sydney</td>
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<tr>
<td>Garrison Central School</td>
<td>In the three years prior to our visit, an enthusiastic teacher, with the approval of the principal, had raised finances from various sources to increase the amount of technology in the school. This resulted in a computer lab in the high school, as well as three computers within each primary class. Professional development of staff in the use of this technology centred on staff members sharing their knowledge with each other on an ad-hoc basis</td>
</tr>
<tr>
<td>128 students in primary school and 124 in high school (30% Indigenous)</td>
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<tr>
<td>A K-12 school on the northern tablelands of NSW</td>
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<tr>
<td>Coalfield Cliffs Primary School</td>
<td>For four years prior to our visit, ICT had been used as a strategy for addressing the school’s aim of enhancing teaching and learning through co-operative behaviour. This was mainly being achieved through the integration of Hyperstudio Multimedia Package into social studies lessons. A teacher- and student-mentoring program had been implemented in the school with two computer co-ordinators acting in the role of teacher mentors. The computer co-ordinators left the school approximately 12 months before our visit</td>
</tr>
<tr>
<td>379 students</td>
<td></td>
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<tr>
<td>The school is located in a relatively new southern suburb of Sydney</td>
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<tr>
<td>Amberdale Girls High School</td>
<td>A technology committee had developed a three-stage technology plan to be completed over a four-year period. Upon completion of stage one, around the time of our visit, the number of computers increased and networking of the school was nearly complete. This addressed their initial aim of doubling student access to computers. Over the following two years the focus of their plan was to professionally develop staff. This was to be followed by a final stage of creating a whole school plan and developing student technology skills</td>
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<tr>
<td>777 students</td>
<td></td>
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<tr>
<td>Situated in the inner-western suburbs of Sydney</td>
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<tr>
<td>Newbridge High School</td>
<td>Our visit to Newbridge focussed mainly on the Year 7 Literacy Room where technology was integrated across the curriculum. Team teaching was an important feature of this program and it appeared to facilitate opportunities for professional development</td>
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<tr>
<td>600 mainly bilingual students</td>
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<tr>
<td>Located in an inner Sydney suburb</td>
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visit was followed by an in-depth interview with the teacher that included a discussion about what was taking place in the class we observed and how the lesson fitted within the broader learning program for the class and goals of the school.

3. Teachers’ views about their attempts to integrate ICT

Many teachers had difficulty answering the question, how had integrating ICT impacted on their classroom practices. Most indicated that it had not fundamentally changed the ways in which they teach or the ways they design learning experiences within the classroom. Our observations appeared to confirm that teachers were largely incorporating the computers available into their existing practices. They tended to integrate ICT in ways that supplemented existing learning designs, often by utilising ICT to replicate comparable tasks completed without ICT. An exception to this was how teachers in the Physical Support Unit at Tall Timbers PS were using ICT to teach children with severe physical disabilities. One computer per child, special peripheral equipment, and specialist software allowed the children to interact with their computers independently of their teacher. As one of the teachers explained:

*These children have such limited hand functions that they can only write with the assistance of a computer. In maths, they can’t use their hands to count or manipulate objects so quite often it’s all done on the computer.... Computers have opened up opportunities that they otherwise wouldn’t have.*

As a result, one of the teachers reported that he saw his way of teaching now as being much more child-centred rather than teacher-directed. He said:

*There’s a lot more child-centred learning... I’ve really become more a facilitator. They just work at their level... I still have input; I have to find the different programs and activities, and set them up, but it’s totally changed.*

In this teachers’ view, the changes in technology have not only changed how he teaches, but also how children learn:

*They have thought up absolutely wonderful things for our children to use; that enable them to be able to write or type. I had a girl in my class last year, who hadn’t been able to do anything independently [because] she couldn’t use the switch. Now she’s writing simple sentences, but four or five years ago she couldn’t have done that.*

Using the available computers, teachers were changing their previous classroom structures from whole group activities to children working dependently at their own computers. However, it was not only the teaching design that changed. A variety of new outcomes for the students became possible, such as producing their own work and becoming independent of the teacher. It was a teacher’s view that:

*Children have moved from mostly group work to working at an individual level – more suited to each child’s independent level of achievement, rather than a group level. It has also changed their level of independence – the work they’re producing is theirs, not mine.*
Technology within this context appeared to impact on the children’s independence as well as the teacher’s accuracy in assessing and planning learning experiences for the students. The teachers were able to teach in a more student-centred way and to design individual learning programs for each child. The take up of technology by teachers of children with special needs does stand in stark contrast to its take up by teachers in regular classrooms. The former seemed compelled to experiment with ICT because of the new opportunities it afforded to students with special needs. The fact that these teachers generally had much lower teacher-student ratios and more resources may have also contributed to their preparedness to experiment with ICT.

However, for the majority of teachers in our study, access to ICT did not appear to impact on their teaching. Although there is some evidence in the literature to suggest that the integration of ICT is associated with a shift from instrucivist to constructivist philosophies of teaching and learning (see for example Barker, 1999; and Saye, 1997), the teachers we interviewed indicated that there approaches to integrating ICT supported their existing classroom practices. These teachers provided considered and confident explanations for integration that were justified in terms of their preferred approaches to classroom practices. A science teacher compared teaching research skills using ICT with teaching how to solder:

Oh yes. It’s very highly structured as you saw. The reason for that was to keep them moving within the lesson. If you just gave them the research topic it would take an enormous amount of time for them to get to base one, just to find a site which had some information on. That’s why I gave them three starting points [websites]… when you’re actually trying to teach a particular skill on the computers, I keep it really structured… if I’m trying to teach a particular skill within a particular time, like, say I’m also teaching that same class how to solder. Alright? Well they’ll have worksheets on how to solder. And we’ll go through it step by step with a whole class following instructions. … So, yes, they’re some things I do in highly structured ways.

Schools were using various forms of leverage to ‘encourage’ teachers to adopt ICT, such as reporting on ICT outcomes, but it was clear that pressure needed to be accompanied by support in the form of professional development. Statements such as the following were echoed throughout each school.

I really think teachers, in general, need training in Internet use. Not just a short program, but some intensive work in how to use the Internet; and how to use it effectively in the classroom...

Encouragement and support were identified as important factors in assisting teachers to work with ICT. As one principal explained:

Because I’m beginning to use it more, I’m beginning to see the extended possibilities. And it can be overwhelming, but I’ve got to keep saying to my staff that the more you get into this the more your vision will expand.

Our overall impression was that teachers’ success in integrating ICT was highly dependent upon the availability of time to think deeply about pedagogical practices; to develop learning programs in collaboration with colleagues; and to trial new approaches to teaching in a supportive environment. Teachers also needed opportunities to develop ICT skills and confidence. However, planned and sustained professional dialogue was uncommon in the participating
4. ICT integration strategies

The participating schools adopted a range of approaches to implementing ICT. Some adopted whole school approaches that appeared to have a number of positive effects; most significant among these, is an emphasis on whole school benefits over those limited to individuals. The principal of Tall Timbers PS described this as ‘a hands-joined approach’:

*We all went to the side of the cliff, held hands and jumped…but I had confidence that the staff would (float). There are enough trailblazers to give us buoyancy and linking the hands really made people more buoyant.*

The assistant principal at this school also recognised the importance of the involvement of the whole school in the planning:

*It’s that school-wide commitment and that’s rare. I think that’s why what we did worked out. … I don’t think that what we’ve done here would easily translate to a lot of other schools without that collegiality, that one-in, all-in sort of thing.*

The importance of involving teachers was also noted by the deputy principal of Amberdale GHS. In collaboration with a feeder primary school, they set out to construct a website for the purpose of facilitating the continuity of literacy and technology programs across the transition from primary to high school:

*The website has been critical to get a mass of teachers involved and skilled in the technologies. The ‘skilling up’ of the people though, has been more important than the website, which is focused on using certain skills and certain texts for literacy and incorporating that and building on that for work in classrooms.*

A clear benefit of whole school approaches, such as those described above, is the involvement of multiple stakeholders in the process of ICT integration. This works against a small group of people, or an individual, bearing responsibility for carrying out the process of integration and encourages a degree of commitment from all teachers. It also affords opportunities for the pooling of skills and resources.

Amberdale GHS focussed their efforts at the Faculty (subject area) level through workshops conducted at regular intervals throughout the year. These workshops were designed to build teachers confidence with ICT: ‘I hold a faculty workshop one afternoon every 3 weeks with the agenda being to play with the computers’ (Technology mentor/classroom teacher). Additionally these faculties received funding to write literacy programs specific to their KLAs. These have been presented on the school web site for each subject. As a consequence, students are able to go to the website for assistance with the writing of reports and the analysis of data.

Whilst the workshops described above relied upon peer mentoring, and local accessible expertise, all schools in the study relied heavily upon external sources of support, including district consultants and experts located within the local community. For example, the curriculum coordinator
at Amberdale described how attendance at external professional development courses guided and motivated the technology team to develop a technology plan:

Five of us went to three in-services…. And we had a lot of homework to do between those in-services and we developed a technology vision as [part of the in-service process]… we put a lot of time into doing that. Working out where our vision was going. And, it was another six or eight months later that we had to do a budget. So we developed a spreadsheet, you know, with just bubbles everywhere and we found that our technology vision was heading in about eight different directions. Some of it focused on teaching and learning, while some of it was just looking after and upgrading the equipment. We developed criteria to rate the eight different areas and we found we were lacking in the information skills side – so we had a huge push on that last year. …

Professional development was identified by all schools in our study as a key issue in the integration of ICT, but for the most part, this occurred in an ad hoc way. The computer coordinator at Garrison CS described this support in the following terms:

I get on top of it, then I show someone else and then I find that 1% of the staff, then 2% of the staff, 3%, 5%, and 80%. Once you get a critical mass of the staff who know how to use it, everybody wants to use it. And there’s also so many students who know how to use it, even if you’re not sure there’ll be a student watching you saying ‘I know how to do this!’… there may be a few failures but you can’t sit back and say well now we’re in charge of this equipment that’s all we have to do this year. You just look for the next thing.

These examples highlight the importance of professional learning and the difficulties associated with creating sustained opportunities in schools. If ICT is to transform students’ learning opportunities, ways must be found to first transform teachers’ learning opportunities.

5. Leadership and succession planning

For some time now, the research literature has highlighted the importance of leadership in supporting the process of ICT integration: Treagust and Rennie (1993) pointed to the need for continuous coordination, and; Sherry, Lawyer-Brook, and Black (1997) focused on the importance of vision and support for technology; and the need for educative leadership was discussed in a special issue of the *Journal of Educational Administration* (Webber, 2003). In our study, we observed different forms of leadership that contributed to the integration of ICT. Here we focus on leadership exercised through school executives, committees, and enthusiastic teachers. Our observations lend weight to the general consensus in the literature that, whatever its form, leadership is an essential element of the integration process.

At the Tall Timbers PS, strong coherent leadership was an important factor in initiating and maintaining the impetus for integrating ICT. The principal advocated the infusion of technology into classroom practices. He understood the core concept of the school’s vision for infusion of computers into lessons as putting pedagogy at the forefront in order to enhance the learning of the children. In his interview, he stated:
We’re coming from a pedagogical base, not a box and cable base, so we’re always looking at our teaching practices and how the box can enhance the teaching practice, and the learning... as opposed to many of my colleagues who talk about the necessity to get their school cabled and get boxes in rooms, I say: ‘To what end? Oh, so that kids can get on the web.’ I think unless you’re being driven by pedagogical approach, it’s too easy for the technology to dazzle you.

The commitment and involvement of the principal appears to contribute to successful integration of ICT, particularly when this process is tightly coupled to the school’s vision for learning. This requires that the principal, and other leaders of learning, are focussed on how ICT enhances, supports and opens up new forms of learning. Whilst schools that do not have their principal actively involved in ICT integration are still capable of making progress, the involvement of a principal, who is intent on improving learning through ICT, has the potential to strengthen and align a school’s efforts.

At Amberdale GHS, ICT leadership was shared between the deputy principal, the curriculum coordinator and the technology committee. This group developed the school’s vision for technology. It provided ongoing and stable leadership for the development of the school’s vision for ICT. It put in place measures for professional development, time release and support. Regular attendees at technology committee meetings were its convenors, the network administrator and a teacher who acted in a mentoring capacity for technology. Other teachers attended occasionally.

At Garrison CS, we encountered an individual who initiated a ‘bottom-up’ approach to change. This motivated computer enthusiast, with the approval of the executive, initiated and developed the use of ICT in the school. He encouraged staff to develop their technology skills, acquire resources and make decisions regarding ICT integration within the school. This teacher’s enthusiasm played a major role in developing his colleagues interests and skills in using technology in their classrooms. He took every possible opportunity to share ideas and skills. As he suggested:

I just keep niggling away at them. I put out lots of enthusiasm and lots of positive reinforcement.

At Coalfield Cliffs PS, we observed the impact on integration of the departure of a key ‘motivator’. This teacher had been part of the original technology committee, and had coordinated the school’s technology integration. The principal noted that he was trying to ‘skill up’ two new teachers to fill the gap that was left. From his perspective, the issue was not one of motivation but skill, as the remainder of the staff had limited expertise in this area. This issue arose in a school that is characterised by a stable staff, but it may be an even more significant issue for schools with high staff turnover, and/or small staff numbers.

A key factor in maintaining stable leadership in relation to ICT is the need for succession planning. This is highlighted by the departure of key change agents and the need to maintain momentum beyond the early stages of integration, which are often led by enthusiastic and committed staff. Members of the executive at Tall Timbers PS stated that they had recognised the importance of succession planning since the very early stages of ICT integration, and they had formed a technology committee to ensure that the development of ICT strategies were not left in the hands of an individual.

We’ve moved steadily with key players coming in and out of [the committee]; some have moved on to other schools for example. We’ve had a clear understanding from the start that what we call the ‘hardware planning’ was simply stage 1. We’ve always had professional development
here in technology. That was quite seriously understood and accepted by all members of staff. (Deputy Principal)

Provision was also made to prepare some early adopters to act as mentors. Both the principal and assistant principal recognised that the mentor training program addressed the possibility of burn out of the key leadership personnel, as well as ensuring that the ICT initiative would continue should key resource people leave the school.

I’m not going to be here forever. And everybody knows that. I love it here. But I won’t stay here forever. I’m not that sort of person. I need a new challenge in three or four year’s time. So, I hope that what happens here, when I leave, is that every thing continues as if I still was here. There are a lot of schools that I’ve seen where one person does everything. And if they leave or they spit the dummy and the whole thing falls flat, the kids and staff are the ones that miss out. So, we’re trying really hard to give everybody expertise and responsibility.

6. The importance of technical support

Whilst this study focussed on how technology is being integrated into learning programs, we were continually alerted to the need for computers to be well maintained and for teachers to have access to technical support. It is clear from our observations that functioning computers, and ‘fast fixes’ when they break down, are essential to effective ICT integration. One teacher explained the situation in her school in the following way:

There’s a constant maintenance problem because things go wrong - just bits and pieces. But you have to be able to resolve those problems yourself. You’ve really got to become adept at sort of understanding your own computers. And you tend to if you have them long enough.

Our findings echo the observations made by the Audit Office (2000) in its report into computers in NSW government schools. It observed variations in the ratio of computers to students; significant variation in the extent of technical support; variations in the amount and type of software available for student use; and identified that some schools had significantly greater capacity to fund infrastructure than others.

7. Conclusion

For the most part, the teachers in our study had deeply considered views about their pedagogy and how it is linked to students’ learning. Their slowness to adopt ICT reflects their efforts to discern how best to incorporate new technologies into old teaching practices. These existing practices generally rely on simultaneous access by all students to textbooks, exercise books, pens, blackboards, whiteboards and overhead projectors. Hence, when ICT is simply substituted for these other technologies, the results are often unsatisfying for both teachers and students because of the limited availability and varying functionality of ICT. These conditions suggest that teachers need support to develop new approaches to teaching and greater access to reliable technology before the powerful ICT learning environments that have been heralded are realised.
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