

SCHOOLING ISSUES DIGEST

Information and Communication Technology for Teaching and Learning



Introduction

The Commonwealth Department of Education, Training and Youth Affairs (DETYA) is publishing a series of brief reports titled 'Schooling Issues Digests' which summarise existing research material on selected topics relevant to schooling in Australia. The purpose of these digests is to provide status reports on the results of recent international and national research on selected topics, in a non-technical, easy to read format, which brings together and demystifies complicated research and statistical data. Contact Irene Kaspar on (02) 6240 5444 or email address irene.kaspar@detya.gov.au for more information on this series. For further information on this particular digest contact Louise Wells on (02) 6240 7886 or email address louise.wells@detya.gov.au

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Overview of this digest

Information and communication technology (ICT) generally relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information. The technologies could include hardware (eg computers and other devices); software applications; and connectivity (eg access to the Internet, local networking infrastructure, videoconferencing). What is most significant about ICT is the increasing convergence of computer-based, multimedia and communications technologies and the rapid rate of change that characterises both the technologies and their use.

Australia is part of a global shift from 'material to knowledge and intellectual resources as the basis for economic growth'¹. The knowledge economy is driven by the requirement for rapid innovation in competitive global markets, and is enabled by the capacity of ICT to store, process and deliver information. Educators across Australia recognise that children must have a school education that enables them to participate successfully in and contribute to that world. All Australian governments are supporting major programs to increase the use of ICT in schools. Many of them are using 'leading schools' and 'leading practitioner' models as a catalyst for change.

The research about ICT's capacity to improve learning and teaching shows that it can play a key role in the complex task of better engaging young people in the learning process². The most recent research about leading practice use of ICT and its effects on teaching and learning shows two main things. First, when combined with effective teaching, the use of ICT helps young people develop already widely valued skills and abilities such as literacy and numeracy³. It also helps with the development of other significant outcomes like higher order thinking skills⁴. Importantly, ICT and good teaching also combine to produce the generic skills, like team work and problem solving, that are so important not only for life in the information age, but also for lifelong learning⁵. Second, ICT can be a major force in re-engineering schools. The strategic introduction of ICT into a school can seriously challenge its day to day practices and help schools more effectively align their teaching and learning programs with the requirements of the information economy and the need for lifelong learning.



The context

In its *Strategic Framework for the Information Economy*⁶, the Commonwealth Government points out that “education and training is a crucial underpinning to Australia’s success in the information economy. Our education and training systems must equip all Australians to be enterprising, innovative, adaptable and socially responsible participants in the information economy”.

In March 2000, The Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) supported the directions set out in the document *Strategic Framework for the Information Economy* in its statement *Learning for the Knowledge Society: An Education and Training Action Plan for the Information Economy*⁷. The Education Network Australia (EdNA) Schools Advisory Group has developed in its statement *Learning in an online world*⁸ a school education action plan in keeping with the current policy of Government. Specifically the document contains two overarching school education goals for the information economy:

1. All students will leave school as ‘confident, creative and productive users of new technologies, including information and communication technologies, and understand the impact of those technologies on society’⁹
2. All schools will seek to integrate information and communication technologies into their operations, to improve student learning, to offer flexible learning opportunities and to improve the efficiency of their business practices.

Examining our assumptions about leading practice

Sometimes leading practice use of ICT for teaching and learning is defined narrowly. This occurs because some functions of ICT are capable of automating learning. The seductiveness of this idea can lead to narrow definitions of leading practice use of ICT to improve teaching and learning. However, as the following review of research shows, leading practice use of ICT can be defined more broadly in terms of it being an enabling tool for improving teaching and learning. It is an enabling tool in two senses. On the one hand, it allows teachers to teach in new, improved ways and it also enables young people to learn in improved ways and in ways relevant to the information economy. On the other hand, it is also an enabling tool in terms of the impact the technology can have on the whole school environment. Thus, leading practice can be defined in terms of how ICT is used, in well-managed schools, to change how teaching and learning are approached. It can also be defined in terms of how it positively influences teachers’ feelings about their work, how their work is supported and developed, how young people view schooling and how administrative and ‘back office’ functions are supported by ICT. This broader definition of leading practice use of ICT for improving teaching and learning is the perspective of this digest.

Overview of the research on leading use of ICT for teaching and learning

The research on the use of ICT in schools and its impact on teaching and learning is expansive. In the context of ICT producing improved teaching and learning relevant to the information economy, the research gives much cause for optimism. This is reassuring given the enormous increase in the use of ICT in the work environment, and its fundamental role in the career preparation of all Australians.

Much of the research focuses on the role of ICT in the successful development of cognitive skills. Other research indicates how, in ICT rich environments, young people develop new forms of learning, including the types of self managed and cooperative learning necessary for successfully contributing to the information economy and for lifelong learning.

Importantly, some of the more recent research indicates how the introduction of ICT into schools has changed them in various fundamental ways and has helped them to create environments that produce improved forms of teaching and learning that have relevance for the information economy.

Improved teaching and learning in Key Learning Areas

Over the last ten years, numerous studies have been undertaken on the effects of ICT on teaching and learning within the Key Learning Areas (KLAs)¹⁰. The focus of this research has changed and evolved in the same way that the ICT environment has changed and evolved during this period.





Early uses of information technology in the classroom mainly involved the use of stand-alone computers and simple data entry devices which did little to change the overall approach to teaching and learning in most schools. However, the emergence of the Internet in the 1990s, and the development of networked environments encompassing a range of computer, multimedia and communications technologies, resulted in a much greater focus on interactive and connected learning experiences for students.

Some of the studies have investigated whether ICT in itself can help to produce improved learning. In one such study, for example, Clements¹¹ showed how young people's meta-cognitive skills were significantly improved in a computer environment. Also, Gerban¹² and his colleagues showed, in a control group study, that a computer simulated science experiment produced in high school students a significantly greater achievement in chemistry, and in science process skills, than conventional teaching and learning approaches to chemistry.

More recently, in Canada it has been shown that the introduction of the computer based mathematics courseware – *The Learning Equation Mathematics* – led to superior performance by Grade 9 students in mathematical knowledge and skills in relation to number, pattern and shape compared to that of children using traditional textbooks¹³. Another recent Canadian study shows that Grade 8 students whose teachers used computers for simulations and applications generally associated with higher order thinking, performed better on National Assessment of Educational Progress evaluations than those who did not¹⁴.

Other studies assert that ICT is a tool for enabling youngsters to think, write, learn, solve problems and perform other mental functions. It is considered to be among the many factors that contribute to learning, including teachers, peers and other tools like writing implements and books. In one such study, Helga Rowe¹⁵ was able to show that some children use the computer to develop appropriate "multiple modes" of learning. These children used a wide variety of learning applications that were closely linked to task demands of the KLAs and the teacher's suggestions for addressing them. The "multiple modes" of learning also accommodated personal aims and skills, personal learning styles and the social demands of the classroom.

Toomey¹⁶ carried out an investigation of Australian and North American Social Science classrooms. With a North American colleague, he showed that the classrooms contained a number of different patterns of learning. Patterns of collaborative learning, problem solving and reflective learning were all evident in the classrooms. The inference drawn from the study is that some teachers are able to use ICT to mediate a student centred, but teacher guided, approach to cooperative learning.

More recently the Center for Applied Special Technology's investigation, *The Role of Online Communication in Schools: A National Study*¹⁷, shows that when children have routine access to the Internet in student centred, teacher guided classrooms, many become more effective communicators, better information processors and better presenters of information. It claims significantly higher scores for online learners on measurements of information management. It also shows that online learning develops superior independent learning, critical thinking, organising and evaluation skills and capacity to present information in compelling ways. This is especially the case in English, Studies of Society and the Environment and Science KLAs.

In short, the Center's research on ICT and improvements in the teaching and learning of the KLAs suggests that:

- when combined with good teaching and learning practices, ICT contributes to the development of advanced skills of technological competence, problem solving, critical thinking and team work;
- when combined with good teaching and learning practices, ICT makes more learning material available and provides more sources of learning; and
- both of the above help students perform better in their study of many of the KLAs, but especially in Technology, English, Studies of Society and the Environment, Science and Languages other than English classrooms.

Equity and other social issues

Some studies have questioned the introduction of ICT on social grounds. Some argue, for instance, that the technology constrains natural sources of creativity and expression and they raise the issue of people being "controlled" by the technology¹⁸. Turkle¹⁹, for instance, asks "do (computer) simulations not only encourage detachment from one's work, but also detachment from real life?" However, the research basis for these concerns is variable. Other people seriously question the introduction of ICT on grounds of what they consider to be the inevitable, inequitable access schools will have to it. Notwithstanding its findings about many schools being well positioned to capitalise on the emergence of ICT, the DETYA funded study, *Real Time: Computers, Change and Schooling*²⁰ concluded that inequitable access was a very real issue in Australia, especially for Indigenous Australians and for rural and isolated young people. Other Australian researchers have identified the issue of access to the technology as a major equity concern²¹. The issue of access is also an international issue²². Equity issues, therefore, must help to shape the research agenda of the future about leading practice use of ICT.

Whole school reform

Since the early 1990s, there has been considerable speculation about the capacity of ICT to 're-engineer' schools. 'Re-engineering' is a concept developed at the Centre for Technology in Education within the Bank Street College of Education in North America. By 're-engineering' the researchers at the centre meant that the introduction of ICT presented schools with an opportunity to change their approaches to teaching and learning, to change their curriculum arrangements and to change their school management practices. ICT was therefore viewed as a lever for whole school change.

Initially, the concept that ICT would enable schools to 're-engineer' themselves was little more than an aspiration. There was little significant research to support it. However, over the last decade a number of factors have contributed to the view being taken seriously by both schools and researchers.

Many schools are now experimenting with new approaches to teaching and learning. They are doing so because they consider it a valuable way to encourage the development in young people of higher order thinking skills such as synthesising, analysing and evaluating, problem solving abilities, working in groups and other lifelong learning skills. They also recognise the relevance of these skills for life in the information economy.

Over the last decade, the research community has been re-orienting itself more towards a non-experimental approach to evaluating the effects of technology in a whole school reform context. More case study work is being done to understand the impact ICT can have on whole school reform processes. The Centre for Educational Research and Innovation within the Organisation for Economic Cooperation and Development is currently managing a series of such studies²³. It is now widely recognised that the strategic introduction of ICT to a school can have the effect of whole school reform.

This view of the reforming role for ICT in schools is widely shared in Europe. In its Report to the Council of the European Parliament in 1995, the European Commission²⁴ asserted that 'the task is to put ICT at the service of innovation and the improvement of the quality of education – for it to



act as a catalyst for change'. It is also being pursued widely in Australia mainly through the use of 'leading schools' and 'leading practitioners' approaches. Other projects, like the Commonwealth funded NATCOM²⁵ curriculum project, are adding impetus to school reform generally and curriculum reform in particular.

In the last four or five years, a good deal of evidence about the effects of using ICT to shape and manage whole school reform has begun to emerge. Much of it has come from the work of the above projects and similar work in other OECD countries²⁶. Introduction of ICT into a school can be managed in such a way as to produce significant changes for both students and teachers. Generally speaking, in a well managed situation, the introduction of ICT as a lever for reform produces changes to teachers as people, to their approaches to teaching, to the curriculum arrangements of the school, to the student learning outcomes and to management practices. In its recent review of the relevant research, Tele-networking Incorporated²⁷ identified seven trends that occur in schools when ICT is introduced as part of a reform agenda:

- there are higher levels of control by learners over their learning;
- learning situations become more realistic and authentic;
- student interest and motivation are very significantly boosted;
- successful online classrooms combine ICT with an appropriate, usually constructivist pedagogy;
- online learning communities challenge locally established curriculum;
- the education of educators is extended to include just in time learning and collaborative learning; and
- educators use online technology as a driving element of further educational reform.

Furthermore, a two year study of the Navigator Schools Project in Victoria revealed that the introduction of ICT to those schools as part of their whole school reform agenda had significant effects on staff and

students alike²⁸. More specifically, the teachers changed in their behaviour and outlook when ICT was introduced with a reform agenda accompanying it. They developed stronger work ethics because they wanted to become more expert in using ICT and were prepared to make the effort to do so. They were happier at work, usually because the students in their classes were more motivated and interested. They felt more professional. They behaved in very collegial ways. They helped each other a lot, especially with developing skills for using the technology to reformulate their approaches to teaching and to curriculum development.

The students, too, were happier in the Navigator School environment. They were able to study things that interested them. They were able to play leading roles with the way the technology was used. They developed a large range of higher order thinking skills, problem solving abilities and other lifelong learning skills.

The research also shows that these positive outcomes are more likely to occur when ICT is introduced within the context of a well-considered technology plan that projects:

- what is to happen about teacher development;
- what is to happen about school management practices and how the school is to be led; and
- what ICT is to be put into place and for what purposes.

Current research²⁹ shows that teachers need skill development if leading practice use of ICT for teaching and learning is to be achieved. They need it not only with using ICT but also with new approaches to teaching and learning that are best suited to a more technological workplace. The research also shows that the development of sound technology plans can contribute to such teacher development. There is a range of innovative management practices that can assist with leading practice use of ICT. Teaching and learning coaches, technology mentors and other management techniques can be used to transform current practices.

Finally other research shows how ICT can improve administrative practices in schools. Johnson's³⁰ study, for instance, shows the improved productivity that accompanies automated timetabling and other automated administration practices.

Conclusion

Recent research on the leading practice use of ICT in schools suggests that it is playing an increasingly important role in enhancing teaching and learning across many of the curriculum KLAs. It demonstrates that the introduction of ICT to classrooms may result in improved learning outcomes, and indicates that generic skills are cultivated in such an environment. Finally, it shows that the introduction of ICT can contribute to whole school improvement.

However, several areas need further investigation and research, as outlined in the table below.

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Areas for further research

Research area	Issues
Teacher development	<ul style="list-style-type: none"> • identifying leading practice professional development activities involving the use of ICT that impact best on teachers and schools
Learning outcomes	<ul style="list-style-type: none"> • the interrelationship between ICT and other factors which impact upon the learning environment and learning outcomes
Curriculum	<ul style="list-style-type: none"> • identifying leading practice examples of curriculum that accommodate the effective use of ICT and determine how it can become more widespread
Whole school reform and school management	<ul style="list-style-type: none"> • analysis of the whole school reform process and the role of ICT within it • which human resource models and management models can be used to reform schools and with what effects.
Equity and access	<ul style="list-style-type: none"> • ways to improve ICT access and literacy of Indigenous Australians and rural and isolated young people



Endnotes

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