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INNOVATING WITH TECHNOLOGY
**The Challenge to Education Policy,
Leadership and Management**

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1 Why use ICT in education

This paper introduces the topic of using ICTs in education from an Australian context by posing the question of ‘Why?’ It then goes on to briefly examine the introduction of computers and the World Wide Web, cites a seminal report entitled *Australia’s Future Using Education Technology*, and finally, refers to a paper about the evolution of methods of communication that humans have developed for common use and which are fundamental to education.

1.1 Introduction

Education in Australia began to examine the uses and benefits of information and communications technologies (ICT) in the early 1990s.

Education authorities in Australia considered that there could be real cost benefits and possibilities for improved learning outcomes and improved services through collaboration and cooperation between the eight states and the national government.

A number of collaborative efforts were initiated by the national government, until in 1997, a national ICT agency in education and training, *education.au limited* was formed. This new national agency was charged with developing and managing national online services to support education policy and to develop strategic alliances nationally and internationally, to benefit all Australian sectors of education.

Australia has a population of approximately 20 million people, most of whom live on the Eastern fertile seaboard. Australia has 9,615 schools, 3.343 million students, over 311,000 teachers and 60,187 students engaged in initial teacher education. Public education managed by State Governments accounts for 67.6% of Australian schools, whilst 19.9% are Catholic and 12.5% Independent schools (MCEETYA, 2004). All schools in Australia benefit from both national and state government funding. In 2006-07, nearly \$9.3 billion will be provided in funding for both State government and non-government schools (DEST, 2006).

Nearly all Australian schools use Australian English as their first language, even though approximately 25% of the Australian population do not have Australian English as their first language.

1.2 Personal computers and the world wide web

The use of personal ICTs has developed since the early 1980s. Originally the Macintosh personal computer and the IBM PC were used for personal information purposes such as writing, book-keeping, managing lists of information and electronic games. When they were networked in the late 1980s, businesses and governments began to collectively store and share files. Schools took advantage of the administrative capability of stand-alone computers some time later, in the early 1990s.

In 1989, Sir Tim Berners-Lee and Robert Cailliau co-jointly invented the World Wide Web (WWW) at CERN in Switzerland. Placement of text-based brochure style information on websites began as a substitute for printed documents, shifting the cost of distributing printed material to the user, in this case to schools. Gradually online services, such as portals, emerged to overtake text-based online documents, which although still available, were often recessed or buried beneath the front pages of online website services. This period also saw the emergence of search engines and national education

portals like the Australian cross-sectoral EdNA (www.edna.edu.au) which provided access to quality educational resources in the form of online digital libraries.

Today the advent of interactive personalised networking (IPN), sometimes called ‘social networking’ or ‘relational networking’ on the web, has rapidly expanded, as exemplified by the rise of blogs for self-publishing online. IPN has developed a culture which services the user through its ability to enable micro-publishing, online sharing and interactivity. There are some very valuable services available for learning. One such example is Wikipedia (<http://www.wikipedia.org/>), arguably one of the best encyclopaedias in the world. It is free and available in many languages.

Both early text-based World Wide Web services and more recently interactive personalised networking have become very powerful and useful online services but as yet they are not integrated tools that can be easily deployed in education for the benefit of teachers and learners. IPN focusses on the user, who in education is a learner and therefore ICTs provide very useful services for teachers and learners.

1.3 Use in education

In 2004, Mr Geoff Spring, one of Australia’s most eminent educators, completed a seminal Australian report for the national government, titled *Australia’s Future Using education Technology*. In that report, Spring argued that ‘ICT could be a major force for improving education while enabling choice for learners’. He went further to say:

It is at the point where the promise of better outcomes for students and real cost benefits are now achievable with minimal costs. We are on the cusp of the first major shift in teaching and learning methodology for hundreds of years where it could be available to anyone, anytime, anywhere. Providing accessibility and flexibility for students and teachers for their own teaching and learning needs remain key challenges. (Commonwealth of Australia, 2000, p17)

Spring was arguing that given accessibility and flexibility of access to the WWW, that learners could make choices about where and when they learn. Learners, in this sense, could be considered to be both teachers involved in professional development and students at a variety of levels. As the services of the WWW become more prolific, the availability of high quality educational material and services for teachers and learners has become realistic.

1.4 Communication in education

Education uses communication as a fundamental tool for conveying concepts, information and ideas which can be processed by learners. ICT is about information and communication, giving teachers new ways for teaching concepts, information and ideas.

In his paper for the *Global Summit 2006*¹, (<http://www.educationau.edu.au/jahia/Jahia/home/pid/305>) entitled *Tools, culture, and education: past - present – future* (<http://www.educationau.edu.au/jahia/Jahia/home/pid/318>), Professor Jim Bosco outlines methods that humans have used to transmit information throughout history.

¹ The *Global Summit 2006: technology connected futures* will be held in Sydney from 17th to 19th October, 2006.

Education and learning, Bosco argues, have been based around transmitting information for social, cultural, vocational and personal development. Verbal and written communication has been a basic tool for transmitting information for centuries. Educators have developed and used sophisticated methods for constructing and measuring learning environments for centuries, as well as supporting students to create knowledge and judge learning outcomes, using verbal and written forms of communication.

Today, ICT offers borderless global access to unlimited information for use by educators, in a connected world. Knowledge can be created in different ways that are unfamiliar to many teachers. These new methods of teaching and learning have been neither tested nor researched by comparison with more traditional pedagogies. Neither the use of information technologies nor communications technologies bear the imprint of long standing and sound research into effective teaching and learning.

However, we do know that effective use of ICTs does improve learning outcomes. For example, the research that BECTa² has undertaken demonstrates a clear correlation between the uses of ICTs and improved learning outcomes, even though intuitively educators know that improved discussion capabilities and unlimited access to quality information are clearly assets that can be used for educational advantage.

For further expansion of this correlation between the use of ICTs and improved learning outcomes, readers are referred to the excellent work of BECTa as a highly regarded starting point, which can be accessed at: <http://partners.becta.org.uk/index.php?section=rh>.

Readers need be mindful of issues associated with research that utilises methods unfamiliar to digital environments. Instead, considering the use of ICTs as part of developing and trialling new learning environments and new learning activities, in order to reflect on their educational potency and effectiveness for learners, may be more worthwhile.

2 Conditions

In order to use ICTs effectively for education, there are a number of conditions that have to be skilfully managed. These include accessibility, flexibility, a shared vision and collaboration.

2.1 Accessibility

Access to computers and connected network services, such as the WWW, need to be readily available without major barriers, for the use of ICTs in education to be effective for anyone, anytime and anywhere.

Accessibility to ICTs in education requires adequate bandwidth, unrestricted copyright, the use of agreed technical standards, and products such as computers, middleware and software.

Bandwidth for education, especially in schools, is a major issue because the numbers of learners who may access online services at any one time does require generous broadband provision. In Australia, education authorities have made considerable inroads in the provision of bandwidth to schools and networking within schools. However, public provision of suitably priced broadband for education by telecommunications utilities in Australia is sadly lacking..

² British Education and Communications Technology agency

Currently, Australia ranks 17th in the OECD countries with about 14% broadband access according to recent OECD statistics³. Such low provision bodes poorly for Australia where 81% of the workforce is occupied in the service industries which rely on access to information. If education is to flourish in a knowledge economy with high levels of literacy and numeracy as goals, then education must be better provisioned in regard to accessibility especially broadband provision.

2.2 Flexibility

In the report, *Australia's Future Using Education Technology*, Spring categorises five modes of e-learning. There are, he states:

... five different modes in which elearning can provide substantial gains in effectiveness, quality and cost benefits

Classroom interactive learning between students and teachers and among students.

Independent learning where students or teachers are learning and studying alone in a variety of environments and modes including aspects of self directed lifelong learning.

Networked learning through contact with groups, individuals and sources where quite different influences and experiences are creating a qualitative difference to both standard and blended learning.

Organisational learning including learning communities, learning precincts and learning cities.

Managed learning where education technology is creating, through computer managed communication and learning management systems, capability to enable teachers to negotiate and provide individualised curricula and learning experiences for students. (DEST, 2004, p29)

This is a good categorisation of the different modes of e-learning and indicates the degree of flexibility that may be required for teachers and learners to apply for effective learning.

Although there will be different costs for each mode of e-learning depending on the scale of implementation, and the levels of access and services made available, the different modes of e-learning do provide a challenge to traditional teaching and learning.

One of the challenges for teachers, in an age when quality global information is available, may be to re-examine the most effective role for a teacher in supporting learning. One of the inescapable conclusions will doubtless be that teachers need to become experts in the processes of learning which varies from learner to learner and is contextually bound.

2.3 Shared vision

The high cost of implementing large scale WWW services for educational use in schools and the requirement for the application of consistent technical standards to ensure that seamless connections and effective information transfers occur, does require careful planning and collaboration among education authorities.

³ Comparison of OECD broadband markets, OECD May 2006 (data Dec 2005), Wairua Consulting

Collaboration can only be effective where a vision for improvement and a better future for education are shared. A shared vision requires leadership for an idea that focusses minds towards agreed targets. The agreed targets need to be both measurable and a celebration of success.

The vision and targets for the implementation of ICTs need to be considered following an examination and reflection of what is happening globally in education and what is feasible at the national, regional and local levels.

One useful document that examines this issue is the *Australian Contemporary Learning: Learning in an Online World* published by the Australian Ministers of Education. This document can be accessed at: <http://icttaskforce.edna.edu.au/icttaskforce/Jahia/home/pid/18>.

2.4 Collaboration

In discussing accessibility, flexibility and a shared vision in the above sections, there has been an assumption, both implicit and explicit, of collaboration and cooperation at national, regional and local levels.

Although decisions at a national level in Australia have focussed on policy, infrastructure and standards, these decisions have been made using regional collaboration. Collaboration can assist to ensure that resources are used wisely and that regional educational leaders understand what shared resources are being made available nationally that can be further enhanced at the local level.

Collaboration occurs when groups come together to share a vision, agree targets, resources and timelines and share commitment to a project. For a brief and succinct summary about collaboration, the document *Collaboration Principles and Practices (education.au limited , 2004)* is a useful starting point. It can be accessed at: <http://www.educationau.edu.au/jahia/Jahia/home/pid/167>.

This document identifies a number of needs including policy leadership at national level, educational leadership to inspire professional educators and management leadership to assist Principals and local education authorities.

Arguably, educational leadership and inspiration, to improve learning outcomes and improve teaching capability without increasing teacher workload, is the most important aspect of the change process that will be initiated with the implementation of the use of ICTs in education. Leaders will need to be open minded about educational improvement and change because the use of ICTs in education will challenge many of the existing educational assumptions about learning. These assumptions arose in the industrial, factory based manufacturing era and although they remain applicable to education today, they are not sufficient by themselves to engage learners.

For example, educators have known for many years that students learn in a variety of ways which vary depending on the topic, the people involved, the local context and many other factors. ICTs can enable different learning styles or modes to take place concurrently. This challenges some teachers' ideas of control, learning measurement and care of educational resources. Therefore trial and error approaches to teaching, facilitated by reflection by educational leaders to find effective practices in local contexts are essential for the implementation of ICTs to be successful.

In 2002, educators in Australia met at the first *education.au limited* Global Summit to consider major questions of policy, leadership and management for successful implementation of the use of ICTs in education and training. The key themes to emerge were needs to:

- Establish and extend online knowledge networks
- Re-conceive the role of teachers and teaching
- Leverage resources to enhance online knowledge networks
- Demystify online education
- Maintain pressure on issues of technology access
- Develop ICT skills for education and training personnel across geographical and organisational boundaries
- Establish a seamless global learning/research framework, and
- Create greater public awareness of the benefits of online knowledge networks. (*education.au limited* , 2002)

These themes have helped to drive policy considerations over the past four years, in Australia.

3 Outcomes

In discussing many of the benefits and conditions for implementing ICTs in education above, one could be forgiven for thinking that there is a big job to be done which will take a long time, use scarce resources and require extensive professional effort. Perhaps it is time in this paper to again reflect on the benefits of using ICTs in education, as the world moves towards becoming a multitude of differently focussed knowledge based societies.

The outcomes of effectively using ICTs in education can lead to:

- More engaged students
- Improved learning outcomes
- More effective teaching and learning without significant increases in teacher workload
- Reduced costs,
- Improved educational services, and
- Economic benefits.

These benefits are worth every effort. Apart from the obvious personal and social benefits of improved education, there would also appear to be economic benefits. In a recent report from the Australian Flexible Learning Framework entitled *Strategic Conversations: the future of e-learning* (DEST, 2006), the following statement is important:

It is estimated that every 1% increase in the stock of skilled workers will lead to a 0.65% increase in gross domestic product. (GDP). (DEST, 2006, p3)

ICTs underpin skill development in today's world and so this may be a very significant statement to consider when thinking about the benefits of implementing ICTs in education.

4 National online educational services

There are many examples of excellent national educational online services. In this paper, only a few have been mentioned. However for a comprehensive review of national education online services resulting from a global scan, the reader is referred to the research report on global gateways entitled *Global Gateways: Transforming Global Gateways through Online Knowledge Networks*.

(*education.au limited*, 2004) This research is reviewed and updated every two years to keep abreast of the provision of national education online services around the globe.

This paper focusses on four such examples of innovative services only.

4.1 EdNA (www.edna.edu.au)

Education Network Australia or EdNA (www.edna.edu.au) is a free Australian repository of quality global and Australian education digital resources for schools, vocational and technical education, adult and community education, and higher education. EdNA has the capacity to locate the best digital resources in the first few search items unlike Google which may have several pages of resources unchecked for quality. Using EdNA to find resources is much quicker and more reliable, in locating quality educational resources, than using Google. EdNA is a dedicated educational resource that is federated globally and utilises quality educational materials.

In addition, EdNA provides collaborative working spaces for educators throughout Australia where documents can be stored, IPN networking services are available, and tools and services for communication and information sharing are provided. Communities using EdNA's collaborative services are managed by themselves. Managers of collaborative communities can elect to manage a public service that is an open service, or a private or closed service.

In a recent review of the value of EdNA, the reviewers stated:

EdNA Online provides a benefit to cost value of a least \$10 for every dollar invested by the Australian government and State and territory governments. (DEST, 2004, p3)

This review undertaken jointly by the Australian Government Information Management Office (AGIMO) and DEST, using a value-demand methodology, reaffirms the cost benefits of the provision of strategically managed national online services for education.

4.2 Learning objects

A small selection of learning objects from The Le@rning Federation (www.thelearningfederation.edu.lau) are presented here as examples of a large scale production of games-like interactive online activities. These learning objects are unable to be reassembled into various teaching sequences such as small modular learning objects can because they have been modelled on self contained digital interactive games. They are compelling, interactive, and relevant for Australian curriculum and have been produced at a cost of about 5c per learning object per student, for Australian and New Zealand schools.

The Learning Federation is an excellent example of collaboration to achieve economies of scale to develop online learning content. Collaboration, in this example, comprised a variety of education sections coming from several different contexts but all having a common purpose. The development costs of the learning objects was reduced through national collaboration and a concentration of expertise which has resulted in high quality digital resources. Australian and New Zealand schools will be the beneficiaries of these centrally developed learning objects which can be used in multiple ways in K-12 classrooms.

4.3 HotMaths (www.hotmaths.com)

Another innovative example of online learning comes from a privately funded service called HotMaths (www.hotmaths.com). This online mathematics service has developed extraordinary mathematics modules which can be manipulated by students and teachers to assist in learning basic and more complex mathematical concepts. HotMaths is using the best of digital technologies to assist teachers and learners. In addition, HotMaths has provided activity sheets which can be printed for use by teachers and students.

HotMaths freely provides online number practice services in the two basic arithmetic processes of addition and subtraction plus their recursive processes multiplication and division. These freely available services allow the student to measure their performance for each session to help judge improvement. The extensive lesson modules, which are world class, are available through the purchase of a license for HotMaths by education authorities anywhere.

4.4 Careers with myfuture (www.myfuture.edu.au)

The fourth and final example given in this paper is somewhat different. It is a service called myfuture (www.myfuture.edu.au) which is Australian careers service enabling school leavers to assess the careers in which they may be interested and then to explore the courses that are available in Australia. The myfuture service enables easy access to comprehensive information to guide students through making careers choices. This pre-eminent global service is unique in the world and very important to Australian students in making career choices.

5 Implementation

Implementation is a major step following development of a vision, collaboration on agreed targets, establishment of infrastructure, exercising leadership and development of policies. In fact, implementation is so important that it very often determines the success or failure of large scale education projects. A common view is that at least 50% of funding spent on ICTs needs to be spent on teacher education, training using ICTs and skilling in technology management and pedagogy for practising teachers.

The use of ICTs in education challenges the very foundations of industrialised factory based learning and values and changes the focus of learning from the transmission of information from teachers to creation of knowledge by students and learners. Teachers play a critical role in this process as experts in guiding choices for learning and creating knowledge.

5.1 Champions

For change in the use of ICTs to occur successfully, specially selected educational leaders or champions, who are respected by their peers, need to be selected and trained in the use of ICTs and the benefits to learning. Champions can be Principals, teachers, educational administrators or lecturers but they must have a passion for learning and a preference for using technology to achieve improved learning outcomes. Their task is to train their colleagues and applaud their colleagues' efforts in finding effective ways of using ICTs in local school contexts. The role of respected educators cannot be under estimated in the change process. Champions will need strong support and adequate resources to complete their mission within a wider plan for the region that is consistent with national planning. A good starting point for considering leadership can be found at: http://www.mceetya.edu.au/verve/resources/Leadership_Strategy.pdf.

Effective champions can generate active online communities of teachers and educators who can discuss issues and receive almost instant feedback from their leaders and colleagues who contribute. The development of communities of practitioners is a powerful tool for change. The work of Professor Dr Gilly Salmon entitled *E-moderating: The Key to Teaching and Learning Online* (Salmon, 2000) is a fundamental guide to development of online communities. This work traces the necessary steps to develop an active an online community in education.

5.2 Partnerships

There are many examples where different national social services have combined to bring services to local communities. Such services can include health, power and water utilities, community services and education. There are several examples of these types of activities referred to on the excellent SchoolNet Africa online service (<http://www.schoolnetfrica.net/>).

There are many examples of successful partnerships between health, power and water utilities, education and community services in the provision of online services for learners and the community which can be located online. UNESCO has developed a number of projects for education using partnerships with other bodies under their sustainable development programs. Information about these can be accessed at: <http://www.unescobkk.org/index.php?id=71>.

Developing community partnerships enables an economy of scale for infrastructure and allows multiple uses of scarce resources in the provision of valued community and learning online services. Partnerships to develop infrastructure and initiate services cannot be under estimated in their value.

5.3 Best practice

In guiding effective use of ICTs, professional educators seek support and feedback from their colleagues which is both time consuming and often occurs only when a random chance arises. Teachers can be supported to develop good practice when they are given opportunities to reflect on good learning practices from a variety of sources.

Universities, especially teacher education bodies, have a role to play in gathering and documenting good practice based on sound educational theories. A good starting point to consider educational theory in a connected world is a paper entitled *Beyond the Horseless Carriage: Harnessing the Potential of ICT in Education and Training*. (White, 2005) Universities involved in pre-service teacher education have a further role to play in disseminating good practice and leading discussion and reflection about observations of good practice using ICTs.

Finding good practice in an environment of change, where compromise dominates, requires careful thought and planning which is time consuming. University education staff can research and document good practice both locally and from global sources. There are many sources of good learning environments and teaching practice, and far too many to list here. However, good starting points includes *ICT Leading Practice* on EdNA (<http://www.edna.edu.au/edna/page2434.html>), Professional Development on BECTa (www.becta.org.uk) and for support of ICT leaders in schools, the work at the Consortium of School Networking (www.cosn.org) is excellent.

Teacher education needs to include good practice uses of ICT in their programs. ICTs in education are as fundamental as books. Pre-service and in-service programs should be developed by teacher education bodies to share good practice, to develop stores of good practice from a variety of education contexts eg early childhood, primary, secondary, country, city; and to provide sound theory and practice for teachers to consider for their own teaching contexts.

6 Openness and sharing

Education is a world wide endeavour and educators are used to sharing information and practice through conferences, papers, online discussions as well as informally. Leaders of change who are encouraging the move towards learning environments that use ICTs need to focus on implementing online services.

There is considerable quality educational content available which can be adapted and modified for use anywhere in the world. Some good examples here are the Teachers Centre on SchoolNet Africa (<http://www.schoolnet africa.net/254.0.html>), and the Global Education Learning Consortium (<https://edu-gelc.dev.java.net/nonav/index.html>).

As knowledge continues to multiply at ever expanding rates and information becomes freely available, openness in education will become a fundamental concept. There is today a need for open content which can be shared globally and some good efforts have begun as mentioned. There are many more.

However, the need for open online services and open networks is even more paramount. Restricted services and restricted networks in education will not be sustainable. The pursuit of knowledge in learning environments needs to be open and shareable using online services. This is due to the enormous amount of knowledge that is being created at an ever increasing rate.

Services operating in an open education environment to benefit education are sustainable through teacher support, professional development activities, consultancy and the provision of expertise. They bring wide expertise and experience to teaching practice and to learning, and are valued by the teaching profession. The implementation of open digital content, open services and open networks underpinned by open technical standards will maximise the educational opportunities enabling re-use of resources, services, collaborative spaces and access to quality expertise.

7 Emerging technologies

The technologies themselves are constantly changing and fortunately for educators are becoming more focussed on education. For example, Nicholas Negroponte has developed the One Laptop Per Child (OLPC) program (<http://laptop.org/>) to deliver a \$US100 laptop for use in education. A number of countries have agreed to supply them to schools. The \$100 laptop is expected to be ready by the end of 2006, according to the website.

At the same time Intel have announced EduWise which is a small, low-cost laptop, built like a carry school case and expected to be ready in early 2007, and then there is the Sony Mylo announced recently. The Sony Mylo is a small communication device that could also be successfully used in education.

In evaluating new technologies, which would appear to be reducing in price, education authorities need to be examining robust technologies for use in school environments and be aware of technology support costs and issues. Regions and largely populated areas will require constant technical support and maintenance. These are costs, that although reducing, must be factored into the purchase of any hardware, middleware or software for use in education.

What is known is that future education services will be:

- web based and accessible anywhere there is a connection
- using wireless
- using mobile devices that can be moved freely from school to home
- operating in an open environment of open services, open content and open networks using open technical standards
- personalised for the learner to learn and manage their own learning in their own way.

There will be many devices and an increasing number of online services that present to education which will need to be evaluated for educational quality, openness, robustness, and inexpensive maintenance and support.

8 Conclusion

There is no doubt that we are living in an increasingly knowledge based age where communications and information have become global. This is having a profound effect on education as educators search for new ways of developing learning environments and educational administrators seek to provide the resources and quality online services for the limited education funding available.

Access to ICTs also occurs at home. In Australia, for example, the statistics about the use of ICTs, clearly indicates that more use is made of ICTs in home environments than at school. Technological devices such as mobile/cell phones have seen one of the most rapid take up periods ever known for devices.

In the midst of the challenges to policy, leadership and management, educators will need to remain focussed on quality education, the needs of the learners and professional development for teachers. At the same time the administrative burdens of teachers can be lessened by technology so that teachers can focus on developing learning environments, suitable for the learners in their charge, that can improve learning outcomes.

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