WEB 2.0 AND THE IMPACT OF ICT FUELLED PARTICIPATORY CULTURE IN RURAL AND REMOTE EDUCATION

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ABSTRACT

This paper and presentation reviews the collective opinion of key Australian researchers concerning the emerging technologies most likely to have a significant impact on learning and teaching in regional, rural and remote areas. It then draws on the conclusions of the Horizon Report (2008) concerning key ICT drivers likely to influence 'learning-focused organizations'. It will examine how these drivers might be influential in practice by reflecting on the forms of 'participatory culture' outlined by Jenkins (2006). International and national case studies will be used to illustrate the practical implementation of these new resources and theoretical frameworks. These case studies include international examples such as the Jhai Project in Laos and the One Laptop per Child Project initiated by Negroponte and colleagues at the Massachusetts Institute of Technology (MIT). National examples include a cluster of schools west of Longreach in Queensland using videoconferencing for teacher professional learning prior to the implementation of a classroom unit enhanced by the use of blogs and robotics, and a cluster of schools in North Queensland building a hovercraft and using dataloggers to monitor and improve performance.

INTRODUCTION

While this paper delivers recorded versions of Australian academics reflecting on important emerging technologies for rural education, it also outlines some key conceptual frameworks developed and published by these academics. Each framework brings into focus different important and useful angles to consider when designing and implementing educational programs enabled by Web 2.0. Discussing Web 2.0 in this context requires a definition and a good starting point would be the ideas of Jim O'Reilly, the author who first coined the phrase and the co-founder of the Web 2.0 conference. O'Reilly (2005) does not give a simplistic definition of the term, but emphasizes that in Web 2.0 models, the users add value rather than being passive recipients and that cooperation is a key feature rather than control. He argues that Web 2.0 involves trusting users as co-developers and provides tools to harness the power of collective intelligence. Web 2.0 is not a product or piece of information delivered to clients, but a collaborative enterprise that affords agency to producers and users. O'Brien (2008) contrasts certain 'Web 1.0' products or tools with others deemed to be Web 2.0: for example, 'Personal Websites' vs 'Blog'; 'Britannica Online' vs 'Wikipedia' and 'directories' (taxonomy) vs 'tagging' (folksonomy). Some useful concepts have put forward in relation to Web 2.0 by Lankshear and Knobel (2006) concerning 'mindsets', McLoughlin and Lee (2008)

'pedagogy 2.0' and Hedberg (2008) 'technologies and representation of ideas and Cope and Kalantzis (2008) discussion on 'ubiquitous learning'.

USE OF WEB 2.0

Lankshear and Knobel (2006) discuss two mindsets that determine to a large extent whether users will simply integrate ICT to replicate existing pedagogical practices or in contrast, allow them to use ICT in new, powerful ways. One mindset embraces an industrial view of production whereas the other adopts a post-industrial view. One focuses on individual intelligence whereas the other focuses on collective intelligence. In mindset 1 intelligence and expertise is perceived as located within individuals and institutions as opposed to a distributed, collective and hybrid model. In their seminal book 'New Literacies they provided a useful table demonstrating the variation between the two mindsets which is reproduced below:

Table 1. (Variations in Mindsets)

Mindset 1	Mindset 2
The world is much the same as before, only now it is more technologized, or technologized in more sophisticated ways: • The world is appropriately interpreted, understood and responded to in broadly physical industrial terms • Value is a function of scarcity • An 'industrial' view of production: • products as material artefacts • a focus on infrastructure and production units (e.g., a firm or company) • tools for producing • Focus on individual intelligence • Expertise and authority 'located' in individuals and institutions • Space as enclosed and purpose specific • Social relations of 'bookspace': a stable 'textual order'	The world is very different from before and largely as a result of the emergence and uptake of digital electronic inter-networked technologies: • The world cannot adequately be interpreted, understood and responded to in physical-industrial terms • Value is a function of dispersion • A 'post-industrial' view of production: • products as enabling services • a focus on leverage and non finite participation • tools for mediating and relating • Focus on collective intelligence • Expertise and authority are distributed and collective; hybrid experts • Space as open, continuous and fluid • Social relations of emerging 'digital media space': texts in change

From: Lankshear and Knobel (2006).

McLouglin and Lee (2008) provide a useful discussion of the characteristics of Web 2.0 and argue that a framework is needed to focus the affordances of Web 2.0 on the learning outcomes that it is likely to support. They coined the term 'Pedagogy 2.0' to label the framework and perhaps hope that the term might become as popular as Web 2.0 which has over 9.5 million citations in Google! They distilled a set of useful guidelines that refer to various characteristics of learning environments:

- Content: Should consist of micro units of content that augment thinking and cognition; may include a wide variety of learner generated resources accruing from students creating, sharing, and revising ideas;

- Curriculum: Should not be fixed but dynamic, open to negotiation and learner input, consisting of "bite-sized" modules, interdisciplinary in focus, and blending formal and informal learning;
- Communication: Students should be offered multiple opportunities for open, social, peer to-peer, and multi-faceted forms of visual, verbal, and auditory communication, using multiple media types to achieve relevance, immediacy, and clarity;
- Learning processes: Should be situated, contextualized, reflective, integrated with thinking processes, iterative, dynamic, performance, and inquiry-based;
- Resources: Should include multiple informal and formal sources that are media rich, interdisciplinary, and global in reach;
- Scaffolds: Support for students should come from a network of peers, teachers, experts, and communities;
- Learning tasks: Should be authentic, personalized, experiential, and learner driven and designed, and enable the creation of content and innovative ideas by learners (p.15).

Cope and Kalantzis (2008) claim that a new educational paradigm is facilitated by digital media and that like 'ubiquitous computing' where processor-based equipment pervades our everyday lives 'ubiquitous learning' leverages the "new ways in which meaning is created, stored, delivered and accessed "(p.576). They propose that seven aspects of ubiquitous computing support new forms of learning - situated computing, interactive computing, participatory computing, spatial computing, temporal computing, cognitive computing and intuitive computing.

Hedberg (2008, p.1) drew our attention to the fact that there was "change afoot and it might prove a pivotal point for the world of digital education". He reminded us that ICT should not only be an effective tool that can be integrated across the curriculum, but more importantly, it can assist us to create or co-create new forms of representation. He discusses the need for a new 'disruptive technology' that will provide a watershed moment where the old is replaced by the new. As an example he discusses the demise of film in cameras with the onset on digital photography and then cites the phenomenal in-roads made by whiteboard technology in some educational districts. What 'disruptive technologies' might be on the horizon that has potential to transform the delivery of education to rural and remote areas? A good place to start is the Horizon Report.

The Horizon Report (2008) produced by an international team drawing on the expertise of 175 advisory board members, along with highly recognized professional associations and ICT communities reported on six emerging information and communication technologies that they predict will have a significant impact on learning organizations over the next 1-5 years. These six emerging ICTs were: Grassroots video; Collaboration webs; Mobile broadband; Data mashups; Collective intelligence and Social operating systems. All of these important technologies, predicted to impact of learning are dependent on decent Internet links, underscoring the national importance of the rollout of broadband to the bush.

Grassroots video has had a profound effect on teaching at James Cook University in recent times. Only a few years ago, the use of youtube in lecture theatres and in online courses was unheard of, but now it has become commonplace. For example, if I am discussing modern educational theorists in a lecture, I show the

students a video of these people talking. If I am discussing the use of 'Webquests' in lectures, I show the pre-service teachers videos of educators planning and discussing webquests and videos of students engaged in webquests. The report points out that "what used to be expensive, and often required special servers and content distribution servers, now has become something that anyone can do easily for almost nothing' (p.3). Collective intelligence and the tools that allow us to tap into the data generated by groups, such as data mashups have obvious application for dispersed populations such as communities in rural, regional and remote Australia as do relatively new delivery mechanisms such as mobile broadband

Jenkins (2006) reporting on the results of a large MacArthur funded study, argues that a participatory culture needs to be nurtured to ensure that individuals and networked groups can fully capitalize on the use of new technologies. This entails the breaking down of barriers to artistic expression and civic engagement and 'strong support for creating and sharing one's creations, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices (p.3). This process of passing knowledge and practices from the most experienced to novices resonates with frameworks such as Lave and Wenger's (1991) 'community of practice' and Gee's (2003) 'affinity groups'. Gee (2003) argued that it is important for learners to be involved in 'affinity groups' in order to facilitate familiarity and competence in new literacies. Affinity groups are autonomous groups of people who have a common bond (e.g. similar interests, or skills). Anderson and Henderson (2004) successfully used the Lave and Wegner community of practice model to deliver web-based professional learning to teachers in isolated areas of Australia. Jenkins sees the benefit of participatory practice as creating expanded opportunities for peer to peer learning, changing attitudes towards intellectual property, diversifying cultural expression and developing skills valued in the modern workplace. The report notes that participatory practice appears in various forms such as 'affiliations' such as online communities including Facebook and gaming communities; 'expressions' such as the creation of new artistic forms such as mash-ups, zines, skinning, modding and digital sampling; 'collaborative problem solving' such as open source communities producing robust commercially viable software and 'circulations' in the form of blogs, podcasts and wikis.

International and national project examples will be presented to illustrate different implementations of emerging technologies for rural education and the following section of paper will outline two contrasting international projects and several Australian projects that have incorporated videoconferencing and other social operating systems to deliver professional learning for teachers. The two examples - the Jhai Foundation Project and the One Laptop Per Child (OLPC) project have been previously discussed in detail by the author (Anderson, 2009). These two projects provide an interesting contrast as the Jhai project is small scale and initiated by the local community, whereas the OLPC project is large scale and, in many respects, a top down approach. Both projects aim to provide access to ICT hardware and ICT training in rural and remote areas of developing countries such as Laos in the case of the Jhai project and various Asian and South American countries.

The Jhai Project

The Jhai project was initiated when Lee Thorn and co-workers introduced organic farming methods and certification procedures to villagers living in remote areas west of the capital, Vientiane. Although the communities did not have access to mains electricity, they placed such an importance on emerging technologies to provide communication and education that they petitioned Thorn and his colleagues to think of some way to achieve this.

Lee Felsenstein, developer of the Osbourne computer and pioneer in the development of publicly available microcomputers, designed a compact, rugged computer specifically for the Jhai Foundation project and the conditions in Laos (http://www.jhai.org). The resultant machine has no moving parts, is small and compact, and has a waterproof case designed to counter the onslaught of the South-East Asian monsoon season. Heat, moisture and dust are potential problem in harsh Laotian conditions so the sealed computer uses no fan, a small energy saving LCD screen, and flash memory chips have replaced a conventional hard disk drive. Finally, the machine has been designed to withstand formidable conditions of different kinds for a minimum of 10 years with little or no maintenance. These conditions include torrential rain, choking dust, and intense heat and humidity at different times of the year.

On the basis of an initial investigation solar power was rejected as a means of powering the unit, due to the cost involved as well as the adverse cloudy and gloomy conditions during the wet season. Pedal power subsequently proved to be a very sustainable method of providing power, and at just one-third the cost of solar energy. A prototype pedal generator linked to a standard automotive battery produces five minutes of computer use from each minute of pedaling.

Wireless connectivity is provided by a standard 802.11b card linked to an antenna located on the thatched roof of the bamboo structure in the Phon Kham trial site. This is in turn linked - via a solar powered repeater station in the hills - to a local Internet Service Provider (ISP) in a larger centre. The system relies on standard and relatively inexpensive wireless hardware components. Perhaps the most interesting component in the overall system is the locally adapted Linux operating system and software for word-processing and simple spread sheeting.

Crucial software components include a web browser for navigating the Internet, a local language version of an open source word processor and spreadsheet package, and a Voice over IP (VoIP) system that makes local and international telephony possible through the standard phone system. These software applications meet the needs and uses of the system expressed by local people. Thorn (2002) identified some of the planned uses. According to Thorn (2002), "Right now, the villagers have no way of telling what the market is in the big towns they sell their stuff to, telling what the weather report is for their crops, things like that. This will absolutely change that. Plus, they will be able to talk to relatives in America some of them they haven't seen in decades' (n.p.).

Access to the computers, the internet and emerging technologies such as VOIP and social computing tools has improved the quality of life of the villagers and enhanced economic and social capital. The program has been extended to other Laotian villages and to the foundation hopes to include sites in up to six other

countries. In this project the community expressed a need for ICT for education and communication rather than having it imposed on them and in addition the uses of the community hub were decided at a grassroots level. Starting in a small way meant that sustainability was more likely and the community would be able to build on the advantages afforded by the technology. Ideas developed for the Jhai project have been adapted for use elsewhere, such as the DWESA projects in South Africa (see: http://www.dwesa.org/projects).

One Laptop Per Child Project

In contrast to the Jhai model, the One Laptop per Child vision was the brainchild of Nicholas Negroponte and colleagues at MIT. Negroponte and (then) UN Secretary-General in 2005, Kofi Annan, launched the prototype of the US $100 laptop at the World Summit on the Information Society (WSIS) in Tunis. The computer labelled the 'Green Machine' was a prototype for an ambitious project under the title of OLPC. Negroponte explained the rationale for lowering the cost of hardware by manufacturing a low cost, relatively small display that would still have adequate performance in conjunction with cutting the excess from bloated commercial software and hardware products and replacing the hard disk with solid state chips. Another cost reducing feature outlined was the voluntary design and project management by many of Negroponte's colleagues, particularly the group at MIT and recruits from the ICT industry. Reducing costs by large scale manufacture was also a key strategy outlined by Negroponte. The ability to power the laptop via a small hand crank was also a feature of the original prototype along with built in networking (including wireless and mesh) capabilities. Since the machine was designed to fulfil a vision of providing a window to world for children in developing countries, it was essential to allow use of the machine where mains power was intermittent, not always available to all or non-existent. Unfortunately, the small hand cranked device was proven to be impractical for generating usable amounts of power for the laptop - unlike the larger bicycle driven powerplant employed in the Jhai project. Like the Jhai device, the hardware was designed to be resistant to damage by heat, dust or water.

Perhaps the most innovative use of emerging technology in the OLPC device is the in-built mesh networking. In most instances, users of the 'green machine' would not have access to formal networks, therefore the ability of the laptops to network or 'mesh' with nearby OLPC devices enables collaboration and use of social networking tools and increases the likelihood of joining a formal network joined to the web. Once connected to the web, OLPC users have access to resources stored on central servers such as software and tutorials. Although Negroponte and colleagues such as Papert clearly recognise that access to appropriate hardware and software alone does not necessarily lead to increased educational outcomes for children in rural and remote areas of developing countries, the hype generated by OLPC often gives the impression that simply possessing the device opens a clear window of educational opportunity for rural children. Studies by Wenglinski (1998) and Malamud and Pop-Eleches (2008) provide persuasive evidence that simply providing children with ICT resources cannot guarantee any positive increase in educational outcomes - in fact, the opposite can occur in certain conditions.

Therefore, it is critical that those responsible for the purchase and use of large numbers of devices under the OLPC project set up conditions to enable and support the use of emerging ICT software tools that suit the needs of children in each particular area.

Both projects have experienced some success in providing opportunities for people in rural and remote communities within developing countries to access and engage with emerging technologies that have the potential to increase human, social, economic and knowledge capitals. Although both projects can claim examples of success, the smaller scale, community initiated Jhai project appears to be more successful. Felsenstein (2005) who was involved with the Jhai Project critiques OLPC as being top driven. He claims that "by marketing the idea to governments and large corporations, the OLPC project adopts a top-down structure. So far as can be seen, no studies are being done among the target user populations to verify the concepts of the hardware, software and cultural constructs. Despite the fact that neither the children, their schools nor their parents will have anything to say in the creation of the design, large orders of multi-million units are planned." (Retrieved from: http://fonly.typepad.com/fonlyblog/2005/11/problems_with_t.html Oct, 6th, 2008). In both instances the use of low cost hardware and open source software drove the design, and a strong argument could be made that this posed a threat to competing computer manufacturers and software (operating system) companies. A response to this threat has been the plethora of low cost 'netbooks' reaching the market and providing a product within the reach of people with limited incomes.

Both projects can be commended for their efforts to provide low cost hardware, appropriate software and internet connectivity to rural communities in developing countries. As the impact of these initiatives becomes clearer, the outcomes can assessed and lessons learned, so that future projects can benefit from these pioneering attempts to leverage the advantages of emerging technologies to assist in human, social economic and knowledge capital.

AUSTRALIAN PROJECTS

This next section will introduce some brief descriptions of two Australian based projects that the author has been involved with through support from the Centre for National Centre of Science, Information and Communication Technology, and Mathematics Education for Rural and Regional Australia (SiMERR) and a third project that was conceived and implemented by the Far North Queensland Indigenous Schooling Support Unit (ISSU). The first project involved very small, isolated communities centred around Longreach in Western Queensland and combined a variety of emerging technologies cited by the recent Horizons Report. These include the use of videoconferencing, video capture and web distribution, podcasting and blogs to enhance the delivery of primary classroom units. The second involves a large scale attempt to increase student and teacher enthusiasm for Maths, Science and ICT by providing highly motivating after-school problem solving activities that combine the discipline areas. In the third project, teachers in the Cape and Gulf areas of Northern Queensland connect to professional development sessions delivered by the Cairns based staff of the Indigenous Schooling Support Unit.

In reporting on the first project in Western Queensland I'll borrow from the previous report at the Australian Computers in Education Conference (Anderson & Cameron, 2008). Four western schools situated in a remote Queensland outback context participated in a cross-curricula unit that involved the integration of ICT in the form of social computing tools (blogs, podcasts and videoconferencing) along with robotics. The key teachers were engaged in professional learning and sharing via National video links with university academics and other teachers in every Australian state who were also situated in rural, regional or remote locations.

In the Queensland model, a key objective was to devise and implement an integrated unit in which the ICT components merged naturally to support and enhance a curriculum unit, rather than a model that introduced the ICT in a standalone, non-integrated manner. Planning documents for the unit state that 'students will learn the difference between non-renewable and renewable forms of energy, and work in large teams to cooperatively research and produce solutions to improve the energy efficiency of a building in their local community. Students will demonstrate their knowledge and findings to the community, and bring their knowledge to life by programming a Lego robot to complete environmentally conscious activities efficiently, within a short timeframe'. This provided an excellent platform to explore the possibilities afforded by new technologies such as podcasts, blogs, videoconferencing and robotics. Given the disadvantages faced by teachers and students living in isolated areas, the technologies promised remote delivery of professional learning experiences for teachers and the capacity for teachers to share their experiences. It also afforded students the chance to interact and communicate with other students spread across vast spaces in the outback.

Teachers participated in a national videoconference where academics in each state presented sessions of a variety of social computing tools. After these sessions, teachers chose from this suite of social computing tools on the basis of 'best fit for upcoming units to be completed in the classroom in the current school term'. Further videoconferencing sessions involved teachers across Australia discussing their plans for the units and sharing advice and questions about implementation. After these initial sessions, post-unit sessions dealt with sharing outcomes. This presented a massive technical challenge since different states use various types of incompatible or barely compatible equipment. Creativity and innovation on the part of participants, along with use of a videoconferencing bridge at University of New England led to successful link-ups. Teachers from the cluster decided to explore the use of podcasts and blogs from the social computing tools and also wanted to include the use of robotics along with undertaking professional learning in the area of video capture and uploading. The author and other members of the national Science, Information and Communication Technology, and Mathematics Education (SiMERR) team provided professional learning sessions via videoconferencing and in addition, the author and another JCU team member travelled twice to Jundah, west of Longreach to provide face-to-face professional learning sessions in video and audio capture and editing, blogging and robotics. Teachers were enthusiastic about the potential of these emerging technologies to enhance upcoming curriculum units.

Interviews were conducted with teachers and students to provide some initial insights on how the social computing tools and robotics were received by teachers and students in terms of value. Positive comments were made about the outcomes in terms of student learning. In relation to the robotics component the key teacher commented:

> The robotics unit was fantastic. Our students had the opportunity to experience a hands-on real-life project that they had complete control over. It was great to see them working together as a team, supporting and encouraging each other. Since completing the unit, some of my colleagues are now very interested in completing the unit themselves this year.

A typical student comment was:

> It was great, we had to work on a really hard challenge but it was fun trying to complete the movements.

This student comment is typical because it although it indicated that the student had highly positive thoughts about the experience in terms of enjoyment, it also clearly articulated the problem solving challenges and the difficulty. In relation to responses from teachers concerning the social computing tools a representative comment was:

> The social computing tools we incorporated in our project enabled my students to expand their horizons within the world of technology. This was fantastic as my students were able to chat to peers from other schools about topics that were relevant to both groups of students. My students' confidence with computer use grew enormously and we noticed the students were more comfortable with using the computers in their free time. The children were emailing each other and visitors and always very eager to check the computers for new emails. As the project progressed, I was excited by the potential of the social computing tools. My school is one of 14 band 5 schools in the Longreach District. All of these schools are geographically isolated and I believe that these social computing tools will be a fantastic way for us to bring our students together around a central curriculum area or unit of study. Social Computing will enable me to have my students working in groups with age related peers from other schools. Our students will be able to use these tools to make networks across our district for support in a range of different areas. In many of our schools we may have only 1 student in a particular year level, with the use of social computing tools we will be able to have a number of students from each year level working together on a central topic. This will be fantastic for our students.

When asked about enabling factors for the introduction of social computing tools the responses were:

- Dedication of the teaching and ancillary staff
- Motivation and enthusiasm of the students
- Interest and support of the parents and community
- Interest and support of education district staff
- Ability to tap into larger networks such as other state school systems and academics at different universities.

Student responses were favourable, for example:

> We can talk to other students about their ideas with the project we are working on. We can share our ideas and try to make better plans from a shared brainstorm session.
>
> And we can look up the answers to questions on the internet or some reference books and share our answers with each other in a forum. We can see what the other kids have said as well.

Teachers identified some challenges of engaging with social computing tools as:

- Lack of knowledge around the use of the tools
- Equipment requirements – what are the latest tools being used?
- Student protection when trying to connect with students from other states.

Students and teachers reported tremendous enthusiasm for the robotics component of the project which culminated in the small and isolated school of Jundah receiving an award in a statewide LEGO robotics competition and also produced a movie showing the rapid development of robotics skills which was presented at a community function and warmly received.

The second example involves a series of projects under different names initiated by the Woree Community Engagement Centre in collaboration with James Cook University, SiMERR and other partners. The combination of partners varied depending on the activity and the following list provides some of the project titles: Maths and Science Excellence Program, Maths and Science Spectacular, Project 5, Outback Maths and Science Show and C.Y. Science. Each project involved a combination of ICT, maths and science through engaging, hands-on activities and aimed at providing professional development for teachers via participation and sharing in the activities during sessions that featured high levels of student motivation. The projects were large scale and targeted exclusively to rural, remote communities, including indigenous communities. The Maths and Science Excellence Project involved 420 students from 30 different schools in an eight week program. The Outback Maths and Science Show visited 120 rural and remote schools in the far north Queensland region and the C.Y. Science Project has involved 43 schools across North Queensland and is set to deliver Phase 2, which will be much larger. ICT is integrated seamlessly throughout the learning modules. A typical example was an activity that involved students building and testing a hovercraft powered by a leaf-blower. Students attached data-loggers to the hovercraft and collected information on a nearby laptop computer that enabled then to graph important variables such as thrust and speed, along with distance traveled. This process facilitated the important 'reflection' phase of the learning activity. The various projects have made use of a plethora of exciting and interesting projects such as building giant catapults to toss a fridge high into the air to firing water propelled rockets off a navy ship in Cairns Inlet. Figure 2 demonstrates the program's success in developing positive perceptions towards the subject matter and delivery. Positive formal feedback was also obtained for the other projects. Although perceptions cannot be interpreted as indicating increased student skill development or increased knowledge of the subject matter, positive perceptions towards maths and science with embedded ICT

is critical at a time of declining student interest and participation in these important areas.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I enjoyed participating in the C.Y. Science Fair.	86%	13%	1%		
The students enjoyed participating in the Fair.	90%	8%	1%	1%	
This was a positive learning experience for the students.	82%	17%	1%		
The experiments were well presented.	79%	20%	1%		
The experiments will be easy to perform.	74%	26%			
I am inspired to use the C.Y. Science Kit with the students.	78%	21%	1%		
I will use the C.Y. Science website to assist me with the experiments.	68%	28%	4%		
The experiments are relevant to the age of the students in my class.	77%	20%	3%		
The experiments areinteresting and exciting for the students.	83%	15%	2%		
The experiments are relevant to the learning needs of the students.	69%	28%	3%		
There was a sufficient amount of time allocated to cover the content and the experiments in the C.Y. Science Fair.	40%	22%	15%	13%	1%
The Fair changed my attitude towards science and maths?	20%	30%	30%	17%	3%
The Fair has changed the attitudes of the students towards science and maths?	22%	47%	25%	5%	

Table 2. Feedback from the C.Y. Science Project

In Queensland, almost all schools using videoconferencing for teacher professional development have shut down their systems due to the high cost of renting multiple ISDN lines. At one stage, this was a viable proposition as schools also used the systems to enable remote delivery of subjects where remote schools lacked the staff expertise to offer specialized math's subject, for instance. When the 'Virtual Schooling' project initiated by Education Queensland switched to a system using computer based materials and audio, the videoconferencing systems ongoing costs could not be justified. Although, video over IP is becoming more viable through software such as 'Skype', the low bandwidth available in remote Queensland schools cannot support it. Perhaps the rollout of broadband to the bush will change this. In the meantime, staff at the Far North Queensland Indigenous Schooling Support Unit (ISSU) have initiated a clever project whereby schools receive a package entitled 'PD in a Box' which includes a laptop computer, a data projector, a wireless broadband G3, usb device with unlimited download for one

year and a suite of PD (professional development) related documents. Schools keep the materials for one year in return for a fee paid to the centre. The centre then delivers short professional learning experiences to teachers in remote areas via Skype based videoconferencing. These sessions are conducted in the evening and often last for around 30 - 60 minutes in the comfort of the teacher's accommodation, thereby eliminating travel time to the school or other centre. The materials are all returned to the centre after one years' use and the annual fee fits well within the typical small school's professional development budget.

CONCLUSION

Although the international and national case studies presented a positive picture regarding developments in ICT access and use in rural areas, an important current challenge in the optimum use of ICT in the current environment is the well documented fall-off in interest in technology by female students, particularly in the upper middle phase of schooling. Previous studies and publication by the author and his research team has highlighted this phenomenon in the Australian context and demonstrated the resultant negative effects on the Australian ICT industry (Anderson 2009, Anderson, Timms, Courtney & Lankshear, 2008, Anderson, Lankshear, Courtney & Timms, 2008). One part of the study examined the engagement of rural and remote female students and their attitudes to ICT and reported that the problems found in the metropolitan areas were slightly worse in the rural areas. Some contributing factors included: the greater number of teachers taking ICT subjects without formal training, less choice offered in higher level ICT subjects and frustration with the long delays to repair of maintain equipment and generally more dissatisfaction with connection speeds (Anderson, Timms & Courtney, 2007). Participatory practice requires ICT tools, such as videoconferencing, to assist in overcoming geographical isolation via communication and collaboration. An Australian study by Taylor and Lee (2005) demonstrated that occupational therapists were more likely to stay working in rural areas when they has access to decent Internet links and basic communication software such as email. Emerging technologies offer much more than this when combined with collaborative cultures, and therefore have even greater potential for supporting sustainability of the workforce along with enhanced educational outcomes for rural areas.

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