Effects of Satellite Communications in the World's Largest Classroom

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Abstract: Satellite communications recently replaced the two-way radio at the School of Air classrooms throughout Northern Territory and News South Wales in Australia. The evaluators of this massive technology innovation surveyed all the participants in the programs. The surveys indicate that the students, parents, teachers and associated people were pleased with the improvements in sound quality and being able to see the teachers. The respondents were very impressed with the improvements in most aspects of the educational communications and by the new opportunities presented by the new satellite-based facilities, the training and access to Internet. A number of areas for improvement of the systems and their operations were also identified, e.g. desired improvements in student and parent training in the equipment use, the sharing of innovative teaching techniques among teachers, exploring the possibility of providing secondary education in the remote areas via this system.

Rural Education in Australia

Since the colonisation and exploration of Australia there has been a concern and commitment to providing a 'fair go' to rural and isolated children and schools. In the early 20th century, support for small isolated schools and isolated students was extended through the concept of a 'correspondence school'. In 1951, this concept was expanded by employing the Flying Doctor two-way radio equipment to create a 'School of the Air', with excited reports of 'transceivers' that had a range of several hundred miles. The first School of the Air (SOTA) was established at Alice Springs. Other long standing elements of rural education in Australia include one-teacher schools, central schools, the country area programs (still in place in 2006), and assistance for isolated children including a boarding allowance and second home assistance.

State and national governments in Australia have thus been active and progressive in shaping policy and undertaking strategic initiatives to provide equity to rural and isolated students for more than 100 years. Parents have always played a key role, not only in providing much of the face-to-face schooling of their children, but also in pushing for recognition of the problems they and their children faced compared to their peers in larger towns and centre. In many cases Australia led the way in this field with, for example, New Zealand, North American and Scandinavian schools swapping ideas, research and professional experience.

The consensus view arising from the various studies conducted over the recent past (Darnell & Simpson, 1981; Human Rights and Equal Opportunity Commission, 1999, 2000; NBEET, 1991; NBEET Higher Education Council, 1999) is that the lack of proximity to a school, college of Technical and Further Education (TAFE) or university appears to contribute to low participation levels for rural, regional and isolated students who have fewer options to pursue career goals locally, and many have to leave for urbanised areas to find work or pursue other interests.

Profile of the IDeL Innovation in NSW and the NT

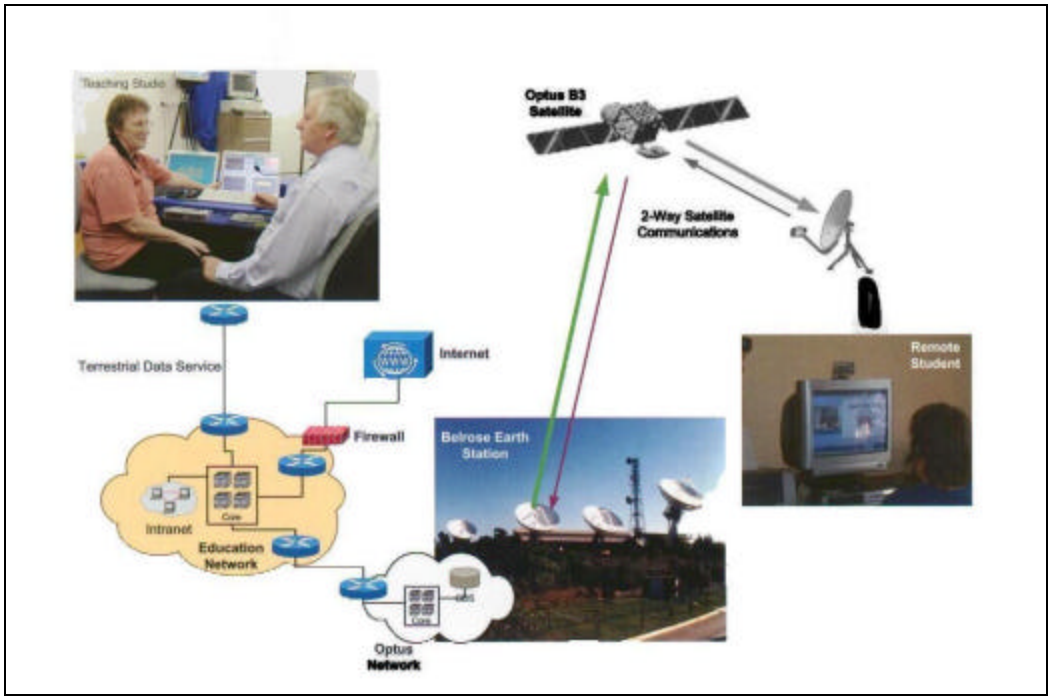
The New South Wales Department of Education & Training (NSW DET), the Northern Territory Department of Employment, Education & Training (NT DEET) and Singtel Optus (a major telecommunications company in Australia) have been working together since November 2002 to set in place a vastly improved system of support for learners in isolated and remote areas of Australia. Together with the Australian Government, $17 million has been invested through a satellite-based communications infrastructure, together with new studio facilities, hardware and software for learners and teachers, and a program of curriculum and teacher development.

This initiative is in response to inequities arising from obsolete and failing existing communications infrastructure, inadequate access to effective education for isolated and rural students and indigenous homelands, and impaired access to education and vocational education and training (VET) due to the limited reach of mainstream services.

The initiative is called IDeL (Interactive Distance eLearning). 'IDL' actually refers to the core software package, capable of supporting *Multicast*. This allows two-way audio to up to two students within a classroom at any one time, e-mail within the classroom between teachers and students, interactive whiteboard activities, application sharing (based on MS Windows), controlled Internet access, recording and storing lessons for student review, classroom statistical calculations, and pop-up questions. In terms of the four main categories of distance education interactions identified by Tuovinen (2000), this project seeks to mainly improve the *teacher-student*, *student-content*, and *teacher-content* interactions, although the *student-student* interaction was also expected to improve due to the improved audio link, although the students were not able to see each other.

The IDeL project provides two-way broadband Internet Protocol (IP) to support interactive teaching and learning for school-age Distance Education (DE)/SOTA students, students and adults in isolated Aboriginal communities, and adults living in small regional towns/hamlets and seeking vocational education. In 2002, it was envisaged that this would entail new technology services being delivered to about 3 700 users, at 547 sites, including 239 small isolated schools (87 of which were NT Indigenous communities). This new infrastructure is being used to deliver primary, secondary, vocational and community/adult education courses, all accredited through the relevant authorities.

Figure 1: IDeL Technology Infrastructure



Source: NCF44 – Interactive Distance eLearning Initiative Annual Report 2002/2003. NT DEET, NSW DET & SingTel Optus Pty Ltd

The project initially established teaching studios at existing DE/SOTA centres, Aboriginal education centres and TAFE Outreach programs (typical studio facilities are illustrated in Figure 2). These were located, in 2002, in regional NSW (Port Macquarie, Dubbo and Broken Hill), and in the NT (Alice Springs and Darwin). In addition, a portable satellite delivery system was set up on a trailer to be taken to remote communities in NSW. However, the services are capable of reception to any location within NSW, the NT and nationally.

The project also established a hub at the Optus Satellite Earth Station (SES) at Belrose in Sydney. Terrestrial communication backbones are being used to provide links between the studios and the SES, and isolated homesteads and communities have had two-way satellite equipment installed at each defined location (Optus SatWeb 2-way VSAT system providing high speed broadband IP access). Figure 1 illustrates the communications links in the IDeL system.

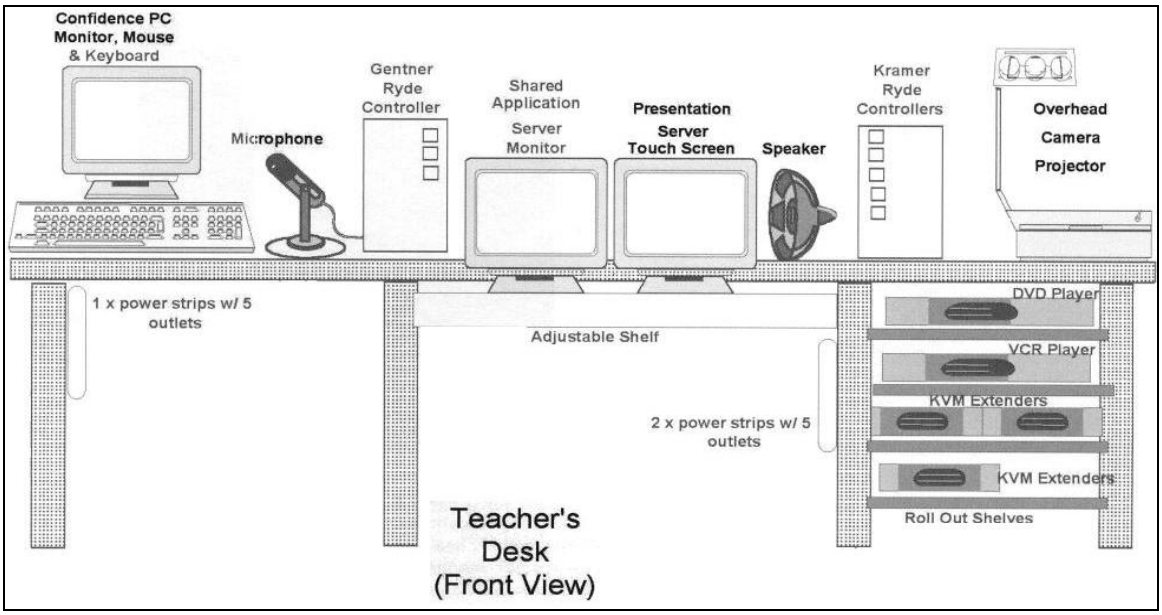
In March 2003, students at homesteads near Broken Hill were the first to participate in an IDeL School of the Air lesson. The students had previously been reliant on two-way radio. Now, for the first time, they *saw* their teachers, were able to *watch* demonstrations, and *view* video-clips, graphic illustrations and computer animations.

While radio is still used to some extent, the shift to satellite delivery of IDeL allows School of the Air teachers and more than 1000 students to communicate using real-time video, shared computer applications, graphics, audio-conferencing, online chat, and email at over 500 sites in isolated homesteads, small towns and Aboriginal communities in NSW and the NT. By the end of 2004, IDeL had brought new technology and educational services to 3 700 users, broadcasting over millions of square kilometres.

The IDeL works towards creating more intimate learning relationships, largely through the addition of vision, but also through the immediacy of the educational exchanges between teachers and students. Audio quality has been vastly enhanced, enabling richer and more broadly shared interactions, and this interactivity is a strong foundation for higher order learning interactions achieved through satellite delivery.

Thus, the key issue in this pilot study was to shape an understanding about what learners need in the context of interactive distance e-learning, from their perspective, and what teachers give them. For isolated learners, the essence of the change being brought about by the technology is the addition of visual modality, fast (and in some cases initial) access to the resources of the Internet, and the opportunity to direct some of their own learning.

Figure 2: IDeL Teacher's Desk – Front View



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Methodology for the Pilot Project

Between November 2004 and March 2005, a pilot project was undertaken to establish some base data for a larger study. The pilot was funded by the service provider and the national Department for Communication, Information Technology and the Arts.

The intention was to gather sufficient data to press for further funding, which has been obtained through a major Australian Research Council (ARC) Linkage Grant. The pilot project undertook to advance the knowledge and understanding within the NSW and NT education systems, and within the service provider (Singtel Optus), about the enhancement of student learning through satellite delivery compared to radio, telephone and print. The report of the evaluation (Crump, Tuovinen, & Simons, 2005) was released in January 2006.

Pilot Project Questions

The IDeL partners wanted an independent review to ensure that the best outcomes were being achieved for the (high) costs involved. Some areas were taken as agreed issues:

- relational pedagogy versus transmissional pedagogy;
- small class size, vision of the teacher taking priority over visions of the student by the teacher;
- quality learning materials;
- teacher authorship of learning materials for IDeL; and
- the benefits of a local (in relative terms!) relationship between students and their teachers.

Less certain were a number of other issues that the NSW Distance Education unit expressed in 2002 as:

- how best to use available channel space;
- how best to provide an expanded service to isolated primary-aged students;
- how best to ensure pedagogies developed for use with satellite technologies exploit the potential of the medium;
- how best to manage lesson planning, programming and timetabling to maximise outcomes in all syllabuses;
- how best to develop exemplary lessons within reasonable workloads; and
- how best to develop opportunities for teacher professional development, community education, and other activities, that would maximise the capacity and benefits of IDeL.

Pilot Project Surveys

Towards the end of 2004, surveys were drawn up for seven groups: School of the Air teachers, SOTA students and SOTA parents; NSW TAFE students and NSW TAFE teachers; NT remote teachers; and IDeL facilitators. The response rates for the students, teachers and parents were particularly healthy, as shown in Table 1:

Table 1: Responses frequencies for survey groups

School age students	135	TAFE Teachers	4
Teachers	44	TAFE students	12
Parents	86	Remote Teachers	13
Facilitators	13		

The analysis that follows provides a description of the participants' perspectives in specific categories and at particular levels of responses. This data was compared to explore relevant group differences and similarities, positive or negative, to enable some elementary inferences regarding current practices and program development.

Qualitative data was grouped into themes and patterns for interpretational analysis to test against the quantitative data, and to partially triangulate with the site visit and documentary evidence included in this Report.

Site visits were made to the School of the Air sites at Dubbo, Broken Hill, Alice Springs and Katherine to collect documentation on the implementation and development of IDeL, to interview the SOTA leadership, view the studios, sit in on school and TAFE lessons (including radio lessons at Katherine SOTA), and, in one case, participate in a school staff meeting. A visit was also made to a western NSW isolated homestead to experience the IDeL environment from the students' and the parents' perspective.

Results – Themes and Outcomes

Acceptance of IDeL

We shall concentrate mainly on the student, parent and teacher responses in the following analysis, as their data is the most plentiful and to save space. In considering how well the IDeL system was accepted by the study participants, we need to note that for many this was their first computer use with a consequent steep learning curve. Installation and other technical issues had to be solved by all, and a huge roll out of facilities and training was accomplished by relatively small teams. In spite of such challenges, the vast majority of participants thought studying by IDeL was a big improvement on previous modes of distance study provision, i.e. using mainly HF radio and correspondence materials. The actual percentages indicating 'better' or 'much better' were: 84% of students and 81% of parents. Teachers were asked if the move to IDeL was worth the cost. 69 % felt the change was 'definitely' worth it, and 23 % felt it was 'only partly' worth it. A typical parent comment was: "In the past we relied on radio for lessons and a lot of 'guesswork' went into what the teacher was explaining. IDeL has helped a lot here."

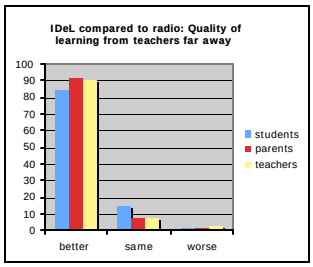
Learning and teaching with IDeL

As noted above, the students suddenly had a whole new raft of technologies available with the IDeL rollout. How well were they and the teachers and parents able to use this equipment and software? All three groups indicated very good ability to use the microphone and computer, the teachers and parents also had very good ability to use the printer and the digital camera, and the parents had a good ability with the scanner. However the students' had a decreasing ability to use the printer, digital camera, the scanner and the graphics tablet in that order. The parents and teachers also found the graphics tablet the most difficult to use, but had better ability than the students particularly with the printer, although the parents' use of the digital camera was similar to the students. With regard to the use of the IDeL software the vast majority of the parents, teachers and students were able to use email, and similarly most of the teachers could use PowerPoint and word processing software, but were not able to browse the Web as well. The parents were highly competent in Web browsing and word processing but had more difficulty with PowerPoint. The students lagged considerably behind the teachers and parents in word processing (their next best software use category), were almost level with the teachers in Web browsing and on the same level with parents in PowerPoint (their lowest software capability category).

When asked, how hard it was for the students to learn to use the IDeL system, 42% thought it was easy and 49% thought it was neither hard or easy.

The answers to the question 'how well, or not, students and teachers, parents thought learning was occurring using IDeL compared to the previous use of radio communications' is shown on Graph 1. It is very clear that all the three groups agreed overwhelmingly that this was a vast improvement on the previous situation.

Graph 1: Comparison of satellite and radio delivery from teachers who are far away



The next issue of interest to the pilot study was what the students, parents and teachers felt assisted them to learn (better) using the IDeL system. All those involved in the IDeL innovation had to be willing to change their practices for learning and teaching in new and challenging context. What is amazing is how willing the vast majority of teachers, students and parents were to try new things, often complex and technologically sophisticated operations that, for some, were very new indeed. The broad range of new factors influencing teaching and learning in the IDeL system included vision, sound, modelling, sharing work, sharing ideas, and so on, in a very immediate way. All participants felt strongly that these new factors assisted student learning greatly. For students, parents and teachers being able to see the teacher, seeing demonstrations and being able to share pictures and writing more easily were the most important aspects. Of major importance, but to a lesser degree were the ability to hear the teacher better and of least importance was the ability to hear the other students better.

In answer to the question 'how well the students, parents and teachers felt they had been trained to use the IDeL system' all the three groups indicated some variations within a general high level of approval response. For example, all three groups agreed on being well trained in the use of the microphone and the supplied computer (taught to use 'well' or 'very well' percentages between 79 – 95 %). The training was less satisfactory on the other hardware, i.e. printer, digital camera, scanner and the graphics tablet, generally all groups approving the training by better than 50% (taught 'well' or 'very well') except the teachers' view of the training in the use of the graphics tablet.

Teachers were provided with additional equipment, not available to students and parents. They felt they were taught to use this additional equipment well or very well, with all but one response (68% for DVD player) being above 70%. This equipment consisted of a CD/tape player, an overhead camera in the studio, a VHS videotape player, a DVD player, the sharing of applications using the IDeL system and the presentation server. With regard to training to use the IDeL software 95% of the students thought they had been 'well' or 'very well' prepared. However, the teachers and parents approval of email training (trained 'well' and 'very well') was about 70%. All groups felt they had been prepared to a somewhat lesser degree in word processing, Web browsing and PowerPoint. The agreement that they had been trained 'well' or 'very well' ranged from 50% - 82%.

The next issue of interest to the pilot study was how well the students, parents and teachers felt they had been supported to use the IDeL system, and how reliable it had proved itself. In addition to being well-trained to effectively use the hardware and software provided through the IDeL innovation, participant perceptions about the reliability of the system are crucial to understanding the extent to which the IDeL system is rigorous and has long-term benefits and options for expansion. The support for the new technology and reliability of the system were reported to be acceptable, especially for an innovation within the first two years of operation, for example in answer to the question: 'Can you get help quickly for equipment problems?' 74% parents and 36% of the teachers answered 'always" and 26% of parents and 64% of the teachers answered 'sometimes'. 57% of the parents and 50% of the teachers felt the IDeL system was 'very reliable', and 42% of the parents and 50% of the teachers felt the IDeL system was reliable about 50% of the time.

The further issue of interest to the pilot study was issues specific to each of the survey groups. The previous analysis has concentrated on issues for which there was common data across the student, parent, teacher and facilitator school and TAFE groups surveyed for this Report. This section will focus on some issues specific to each group to illustrate further key findings, before reviewing what each of the groups saw as challenges and possible improvements for the IDeL. In the survey the students were asked 'How often do you use the IDeL equipment or software?' with the available responses being Never/Sometimes/Often/Not Available. The students reported that they 'used often' (if available) the computers (82%), microphones (78%), email (64%), printers (53%) and Web browsing (44%) in decreasing order of frequency. They 'used sometimes' digital cameras (47%), PowerPoint (45%), the graphics tablets (39%) and the scanners (39%).

The change to IDeL was thought to be educationally appropriate by 80% of teachers, while 21% thought it was only partly appropriate. Learning produced via the IDeL system was 'definitely' transferable to other contexts

according to 66% of teachers, 23% thought it was 'only partly' transferable and 9% thought it was 'not at all' transferable. The benefits of moving to IDeL delivery were 'definitely' worth the investment costs to 69% of teachers, with 23% believing that IDeL was 'only partly' worth the costs, and 9% reporting that IDeL was 'not at all' worth the costs. Nearly all (98%) of teachers agreed that they had been willing to try new methods and content with IDeL, while the remaining 2% neither agreed nor disagreed with this proposition. Three quarters (75%) of the teachers agreed that the technology had promoted pedagogical risk taking, while 22% neither agreed nor disagreed and 3% disagreed. Of the teachers surveyed, 65% felt they had to change their teaching practice developed for previous distance education practice, while 27% neither disagreed nor agreed and 9% disagreed with this. The vast majority (95%) of teachers agreed that they enjoyed teaching via IDeL, while 5% neither agreed nor disagreed with this sentiment. This is an important finding, as it indicates teacher satisfaction with the extra capability the IDeL system provides for teachers to achieve their professional goals.

One topic of discussion for the **parents** during site visits was the extent to which IDeL had improved or weakened the relationship between home and the school. In many cases, it was felt that IDeL had made a dramatic improvement to the medium, style and quality of communications, with school assemblies, Parents and Citizens meetings, expert and celebrity visitors, and some public events brought to life over IDeL, e.g. one parent said "Being able to communicate [with the school and other parents] via email is great. Visual P&C meetings are a great improvement." In some cases, there was a sense that aspects of the school's community life had been lost, such as all singing together over radio, and in some cases radio lessons have been continued for this purpose, especially for younger students. However, the introduction of IDeL has meant the re-arrangement of many aspects of the students' learning, so that things once only possible during residential school can now be done online, and things once done over radio, like choir, have been shifted to the times when the students are all together for mini-school, camps and sport events. The quality of communication between the family and the School of the Air via SEP was thought by parents to be better (67%), the same (28%) and worse (5%) when comparing radio to IDeL. The quality of communication among the School of the Air families was thought to be better (45%), same (28%) and worse (27%) with IDeL.

With regard to how well their child likes to learn by IDeL than before, 87% of parents responded their child(ren) were learning 'better' (39 %) or 'much better' (48%), 10% thought they liked it 'about the same' as before, 10% 'not quite as well' and only 1% (one child) thought they liked it 'much worse'.

Challenges and improvements for IDeL

The final issue of interest to the pilot study was what the students, parents and teachers felt were challenges using the IDeL system, and how it could be improved. The perspectives illustrated in the first two themes can be further illuminated by reviewing what students, parents and teachers felt were the challenges of learning and teaching with IDeL, as well as the participants' perceptions about what improvements could be made. Generally, comments about challenges and improvements were made in a very constructive spirit, often starting with a comment about how much of an improvement it already is, but that it could be made better by trying this or that. Most respondents understood very sensibly that the IDeL innovation was less than two years old, in many cases less than one year old, and had been rolled out widely and rapidly which embodied difficulties and problems of its own. The participants understood that IDeL was already evolving and that those responsible for the management and development of the IDeL innovation were very conscious of the need to ensure that all was working well on any one day, but also that the system has to keep moving forward to meet new infrastructure and technology benchmarks, as well as raised expectations within the client groups.

The typical **student** challenges identified were the computer 'freezing' and sound problems, forcing the teacher to repeat things which becomes disruptive to the lesson. The **teachers'** perspective is neatly summarised in the quote" "When it works well, it's terrific. Need to have a backup plan. This creates anxiety and [extra] work load. Despite the challenges, there are great opportunities for teachers and students." The **parent** challenges are encapsulated in the statement: "When it works well, it's terrific. Need to have a backup plan. This creates anxiety and [extra] work load. Despite the challenges, there are great opportunities for teachers and students."

The improvements the **students** desired were related to being able to have more than two people in a conversation at once, less computer freezes, teachers talking less and providing more student activities, the teachers and other students being able to see the students, students being able to select the camera view of the studio, teachers becoming more capable in using the IDeL system, having longer IDeL lessons and doing more of the schoolwork in the IDeL sessions rather in hard copy form. The **parents** zeroed in on questions of having a studio at Katherine, better training for teachers, greater availability of IDeL throughout the day, more help for computer novices,

availability of dual headphones, interest in TAFE courses for parents, and the issue of reducing power usage by the IDeL equipment. The **teachers** provided a broader, and generally more critical, list of things they wanted to see improved than other IDeL participants, but some were positive suggestions. They wanted less buttons to control while teaching, need to see the students, more time to teach their classes, elimination of the transmission delay, more training, ensuring the system works consistently and more time to prepare class materials.

Conclusion

A very complex, large-scale and ambitious program of improving the HF radio-mediated distance education program by the introduction of interactive satellite-mediated video broadcast and feedback was examined in this evaluation. Not only were the changes a huge step forward technically but they also challenged all the participants to make the best use of the extended affordances of the systems in the world's largest classroom. Despite huge hurdles to overcome there was an enthusiastic endorsement of the innovation by the students, parents and the teachers. Very clearly the television-quality presence of the teacher in the remote students' homes and schools made a huge difference. The improved voice communications allowed the students to understand more precisely what the teacher was saying as well as being able to see what the teachers were demonstrating. Quite remarkable innovative uses of the system capabilities have been demonstrated by the IDeL teachers. For example, one teacher developed and rehearsed a script for a movie about Australian explorers and animals using IDeL without having the actors ever meet together before the actual filming. The movie was in fact filmed in three different locations at the end of the term during the regular meeting of the students with their teachers (Towers & Coad, 2005). However, the evaluation also unearthed useful directions for further refinement of the system and its implementation, which provide desirable directions for the resource providers to follow as they seek to improve the educational provision for the isolated students in Australia's outback.

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