Interactive distance learning technology and connectedness

Brian Devlin
Charles Darwin University

Peter Feraud
SingTel Optus Pty Limited

Alan Anderson
University of Newcastle / Southern Cross University

"... the beauty of IDL is mainly visual"
(Interview with KGTI-6)

Abstract

This three-part paper discusses how the contemporary use of computers in distance education is helping to connect students from our rural communities, whether they are located at pastoral stations, remote community schools or are on the road, travelling with parents or carers. The paper is in a sense organised like a sandwich, with technical detail functioning like pieces of bread at either end of the paper and some comments by parents and teachers providing the filling in the middle.

The first section of the paper provides an overview, from the perspective of Optus, of the satellite-based infrastructure that underpins interactive distance learning (IDL) services in the NT and comparable Interactive Distance e-Learning (IDeL) programs, such as the Satellite Education Program (SEP), which are managed through the Dubbo Rural and Technologies Centre in New South Wales. The second section then briefly explains how the infrastructure is being used, drawing on the research we are conducting into this form of e-learning as part of a broader Australian Research Council Linkage (ARCL) project. This research uses a mixed-methods approach that incorporates quantitative analysis of system-level data and qualitative investigations of data obtained from interviews, observations and surveys. While brief reference will be made to such notions as interactivity and interaction in distance learning, our focus will be on an analysis of some practical issues, which will be illustrated with an exemplary video clip of online teaching. The concluding section of our paper summarises some likely infrastructure improvements, while at the same time asking whether teachers and administrators are well positioned to take advantage of the new possibilities. Please note that, in place of the correct but cumbersome acronym *IDL/IDeL*, we have referred to *IDL* throughout. The codes in brackets (such as KTI-8) following some quotations cross refer to the transcripts of interviews in our dataset.

Introduction

This paper draws on ARCL project LP562535, "Opening Our Eyes" (OOE), which began in late-2006 and will continue until August 2009 and is now supported by five agencies: the University of Newcastle, Charles Darwin University, SingTel Optus Pty Limited, the Northern Territory Department of Employment, Education and Training (NT DEET) and the New South Wales Department of Education and Training (NSW DET). The research project comprises three strands, which in turn aim to (1) analyse IDL policy implementation, (2) examine the teaching and learning experiences of IDL users, and (3) help IDL users—the teachers, students and parents—to share their experiences with the aim of improving the quality of this form of education.

The present infrastructure

Interactive distance learning is the platform that has been used since 2003 by the government education departments in NSW and the NT to deliver distance learning to remote communities. That is, IDL is their primary vehicle for delivering educational services to School of the Air (SOTA) and other satellite-supported distance education school students located in remote and isolated parts of the country.

This IDL platform uses Optus satellite services as a basis to deliver content and allow communication between teachers and students. Due to the relatively long round-trip-time incurred whenever satellite communications are used, enhancements using terrestrial communications are implemented where possible. Content is relayed by multicast video, two-way chat, filtered world-wide-web access and derivatives of these.

From a high–level perspective there are four variants of access provision, as shown in Figure 1.

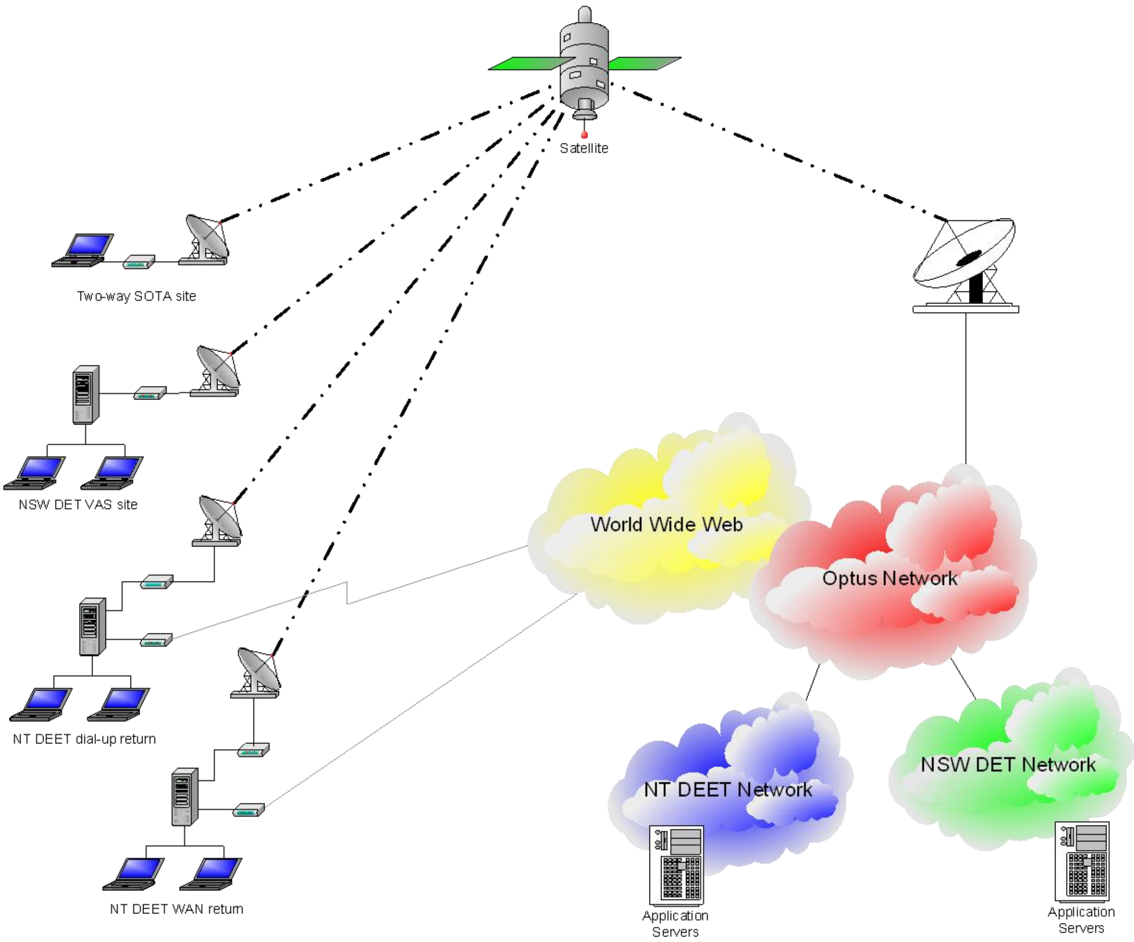

Figure 1: High level arrangement of the IDeL communications network

These platforms support software applications, such as OneTouch™ in NSW and REACT™ in the NT, which allow the delivery of teaching content, interactive verbal communication and results gathering to allow teachers to reach out to remote students and deliver a state-of-the-art learning experience.

How the platforms are used to connect teachers and learners

In New South Wales

Historically, interactive distance e-learning developed out of an early initiative first trialled in the Broken Hill region. By 2008, however, the service has matured to the point where it incorporates two-way satellite services to 52 remote schools and 235 isolated home sites, as well as a broadband terrestrial wide area network connecting administrative offices, TAFE campuses and approximately 2,500 schools. Centralised through the Dubbo Technology Office, the program currently utilises the US software program OneTouch and supports it with Polycom IP Video Conferencing and Bridgit™ data-conferencing software. Students are able to interact with their teacher and each other using e-mail, voice, chat, graphics tablets, digital camera/scanners and various software applications that allow sharing with each other and the teacher.

In the Northern Territory

The distance education service in the NT has evolved out of School of the Air programs at Katherine and Alice Springs which formerly relied on HF Radio and correspondence material. Teachers at those sites work with geographically dispersed students and are assisted by a governess or a parent serving as home tutor. Students served from the Northern Territory Open Education Centre in Darwin tend to be either located at a remote secondary school or are working on their own. However, some students who are travelling extensively are also catered for. IDL programs are decentralised and largely managed onsite. For example, one of the IDL leaders flies his own plane out to remote stations to install and repair equipment and provide other forms of support. NT DEET's preferred remote education conferencing software for the provision of Interactive Distance Learning is REACT™, developed by Michael Wilson, who is based in Darwin. Teachers and students also make use of web-assisted techniques ('online environments'), e-mail, chat, voice and various software applications in their communications with one another.

Exploring the users' perspective

The link between education and technology as perceived by parents and teachers

As part of Strand 2 of the ARCL project, researchers have been observing IDL lessons and interviewing stakeholders in order to develop a better understanding of how students, teachers, parents/carers and others use the technology, what they feel about their engagement in IDL activities and how those experiences influence their perceptions, satisfaction, behaviours, working practices, learning process and (learning) outcomes.

Our investigations into interactive distance learning encompass the *synchronous* classes broadcast via satellite from school studios, various *asynchronous* communication methods such as e-mail and threaded discussion lists and *off-line* modes of assistance (for example, following up a student by phone after an IDL session). However, our attention is primarily directed to how the **real-time use** of desktop conferencing tools that is at the core of how the IDL program helps to *expand the curriculum*, ensure *peer interaction* (opportunities for collaborative learning); and maintain *connectedness* (access to distance education, engagement, the feeling of being in touch with others). This is a key point of difference between our work and other studies, such as Palloff & Pratt (1999, 2001), which are primarily concerned with asynchronous online learning and communication.

Pelliccione and Albon (2004) concluded, in a report on their study of mentoring, that open communication skills were of primary importance in building a sense of connectedness: "Students indicated that *connectedness* was formed by acknowledging another's problem and an ability to foresee not only the problem but strategies to solve it in a way they understood" [Our emphasis]. In his analysis of why many distance education institutions had incorporated the Internet into their courses, Shearer (2007, p. 225) deduced that they had done so "in order to provide a greater sense of connectedness between the learners and the instructor and institution" and "a greater sense of community and timeliness of feedback". What was not clear, he went on to say, was "to what extent this limits the number of students who can enrol in a single section of a course. For once we as designers add greater interactivity between the student and instructor, we limit the number of students a faculty member can effectively interact with".

According to one adviser interviewed for this project (T2), "the value of IDL is not just the IDL lessons, it's the technology that comes with those IDL lessons and it's the value-add stuff that that technology brings into the homes, so to speak". Yet a number of the teachers interviewed by our research team are adamant that, for them, technology is not the tail that wags the educational dog. These teachers make a point of stating that their teaching is not technology-driven, although they can see the value of being able to use the technological tools and devices that are available. For example, one explained that:

> We choose not to say: This is the technology available so how will our lesson look? We choose to say: What do we want our lesson to do and now how will we make the technology work for our purposes?
> (Teacher B, cited in Anderson, 2008, p. 6).

In other words these teachers, who routinely plan and teach ICT-assisted lessons, argue that it is important to start by identifying the desired learning outcomes and then consider what approach, resources and technologies they can make use of to achieve that end. Consequently, in spite of the wide array of technological tools at their disposal, there are times when a multimedia-lean rather than multimedia-rich approach is used. "Online chalk and talk", one teacher has called it.

> Teacher B: I can honestly say that every lesson I have run this week has not required any electronic media.
> Researcher: Yet another time you might use Bridgit and other things.
> Teacher B: Yes Bridgit, Smart boards and everything. Just whatever I need
> (Teacher B, cited in Anderson, 2008, p. 6).

Our interviews are still in progress, hence it would be premature to generalise about how most teachers approach their IDL teaching. However, the research team is gaining a better understanding of how teachers decide on the most appropriate technology to use for particular lessons and purposes. It is anticipated that such information will help with professional development and possibly inform the writing of training manuals and information guides for new IDL teachers, supervisors and students.

There are now fewer limitations on what can be taught via distance education. As one parent put it, referring to her own home-schooled children, "they can just get to see so much more" (KHTI-310). This parent found, for instance, that the assemblies on Friday morning were "a huge motivator" for her children": "to have their names brought up in front of other people. They just feel so proud. If they're going to work really well, they see the point. There are rewards for their hard work". In an IDL class science can now be demonstrated using USB microscopes. Posture, dance steps and letter formation can all be demonstrated by the teacher. Music benefits from visual illustrations of particular musical instrument techniques and the use of MIDI-compatible music keyboards can be shown in conjunction with computer when using music recording and editing programs such as GarageBand™. (In this conference presentation we will show still images and a little video of a teacher using the document camera in a unique way for teaching recorder lessons, drawing on Anderson, 2008).

One teacher was dismissive about her earlier experience as a SOTA instructor, claiming that "radio was only audio, which wasn't very good at all" and "we are doing more teaching now on IDL then we ever were on radio" (ATI-15). "When IDL came in", this interviewee went to explain:

> because you have got visual, the kids can actually see what I am doing so if I explain things like long multiplication when I taught the upper primary, they can actually see what I am talking about, rather than "carry this one here" and the kids who are being polite will always say, "Yes, I know what you are talking about". I can actually show it to them. (ATI-15).

While the importance of the visual medium in IDL is not in question, it is bringing about some unanticipated changes in the mediating role of language in distance education. As one teacher has reported, resorting to a little exaggeration to drive home the point:

> I came from teaching on radio where language was so important—fiddly, descriptive language—and I find that I don't have to use it anymore, so in effect, I've become lazier in my speech on IDL because kids can see everything and I don't have to describe anything. And children's descriptions of things, we really have to push them to say "Yes and", "Yes and", "And what colour is it?", because I think they feel because they can see us that we can see them as well. My descriptions of things, I don't even have to describe things, I just put it under the camera now, so my teaching of language I feel is falling down and increasingly so, even out of school, I've found that I'm becoming much lazier. I just go "Oh that" and it really has affected my language in that way …. The fact that children can see things is great, but parents are also noticing the language side of it going downhill, because we don't have to use the language anymore. It's all visual. (KGTI-6)

How teachers adapt to the current physical constraints of teaching via IDL

In our research a distinction is made between the concepts of *interaction* and *interactivity* (Roblyer & Ekhaml, 2000). The first refers to the task-oriented and person-oriented behaviours of individuals who are working together in a group; the second refers to the "technological capability for establishing connections from point-to-point … in realtime" (Wagner, 1997, p.20). "Thus, interaction focuses on people's behaviours, while interactivity focuses on characteristics of the technology systems" (Roblyer & Ekhaml, 2000). However, Roblyer & Ekhaml (2000) go on to say that

> Even if one accepts this distinction, it is evident that these qualities are linked and that both are necessary to achieve the qualities students find so desirable. Also, it is clear that there is a relationship between these two qualities in distance courses. Technologies that allow high interactivity seem necessary to allow high person-to-person, person-to-group, and person-to-system interaction.

One interactivity constraint in IDL is audio delay or latency, which can affect the interaction between teachers and their unseen students. In some of our interviews teachers have admitted that, in order to compensate for this, they sometimes anticipate the student's answer or actions.

Teacher B: I am making some assumptions that it is happening at the other end. … I give the response of 'excellent but … that's because I know children don't tuck their finger in [when playing this musical instrument], not because I can see anything. Parents often say: 'How did you know?' That's just years of teaching that you've got to anticipate what's happening at the other end.

It is worth noting that, in the example cited above, the teacher had the necessary expertise to recognise the sound of an instrument not held or played properly using the correct finger positioning. In some cases, however, being too quick to anticipate an answer or an action could leave a student and supervisor feeling deprived of their chance to respond before the teacher has moved on in the lesson or begun to communicate with another student. This was one parent's perception:

> I just noticed with the teachers giving their lesson that, if they do not understand that if there is a delay and … at home we can hear the other students speaking, but the studio cannot. So, sometimes, you have actually heard what the students have said; the teacher has not and they get a different perspective of what the child has said. And, also with that delay, they can either cut words off or not wait for the end of something, which can give a completely different answer to what the child has said. So, it can give a different spin on the lesson and if the teachers do not understand that that happens, it can just reflect differently on the kids (polBPHT_401).

Fortunately, teachers make occasional home visits to the homes of IDL students and, as the same parent commented, this can help teachers to appreciate what things are like from the student's perspective.

Parent: I do not know how to explain it, but once the teacher has been out on a couple of home visits and they have seen that that happens; they understand that it happens and therefore the way they give a lesson is different (polBPHT_401).

It is apparent that there are particular communication strategies required to teach effectively in this context.

Our interviews indicate that an obvious constraint for a teacher working with a one-way video system is not being able to *see* the students. In one interview Teacher B discussed the importance of keeping students engaged in a lesson delivered via satellite and the challenges facing teachers who are not able to see what is going on at the home site:

> you need to have them do something. And that was something that we were made aware of. [Teacher C] happened to be at a home visit and there was a satellite lesson on and the child was hanging off the chair – the lesson was happening – and that was when we became aware that we had to have more awareness of how we are engaging the children and making sure that they were involved in the lesson, rather than just talking to them and given information.

In contrast, some of the benefits of return video (two-way desktop videoconferencing) are evident in this observation from the developer of REACT™.

> I have been involved in 'return video' proof of concept trials for some time and I am familiar with the negative discussions concerning issues of privacy etc. Earlier this week was my first exposure to an actual lesson in progress and I was instantly persuaded as to the value of this tool. The lesson involved a student from a remote … community. I had on a number of occasions observed lessons that included that student and I had in my mind classified the student as being somewhat slow (not a technical term I am sure) and assumed from his attitude that he probably resented having to be in the lesson. He needed constant coaxing from the teacher in order to extract an answer to even the simplest of questions. However when observing the student via return video it was immediately obvious the student could hardly sit still with excitement and was responding to questions by enthusiastically nodding his head. Within a matter of moments the IDL teacher had pointed out to the student that normally she couldn't see him nod his head and that he needed to speak out with his answers (Wilson, personal communication, 28 March 2008).

As one teacher observed in an interview, “The other thing I also think would make it better for teachers is the bandwidth affair...If we had the bandwidth, you could have more than two kids on talking, you could have video coming back to you” (KTI-8). More bandwidth is a common request from all stakeholders, including teachers, parents and home tutors and even students. However, in spite of some apparent advantages, it seems unlikely that the option to use return video on-demand will be made available to all teachers and students in the near future. Desktop videoconferencing is bandwidth intensive and has the potential to overload computer networks, causing problems for other users.

This limitation is frustrating for some teachers. As one explained:

> I think the bandwidth would make all the difference. The teachers are flexible and adaptable and work with what they have got, but if they had the bandwidth to have that greater interaction and they could have five kids talking to each other. (KTI-8).

Another teacher was even more emphatic:

> Here we go. Broken record—*two-way vision is vital*! I know that it’s probably costly and it’s technical and it will take awhile but to get feedback from the students, to see their faces when you talk to them so that when you explain a concept to them, to see the look on their face whether they grasp the concept or not, this is classic in traditional classrooms … (ATI-15)

However, as Moore and Lockee (1999, p.3) reminded us almost a decade ago:

> Instructional design theories recommend that instruction be designed before media is chosen … in the practice of distance education programs, such procedures are rarely possible. Designers usually will have some idea of the system in which they will be expected to present. One instructional parameter that is usually fixed is available bandwidth in which the instruction will be presented.
>
> Distance educators must recognize the limitations that their bandwidth capability provides and attempt to maximize this resource to its highest instructional possibilities.

Future technology trends

The points that follow reflect a view from Optus rather than issues or findings emerging from the research. Most of the challenges facing any remote communication strategy relate to the scope of the communication medium and the capability of the core application. Addressing these challenges relies on advances in the ubiquity and amount of *bandwidth* available, the *capability of remote devices*, and *capabilities in the application layer*. These will now be briefly discussed in turn.

Bandwidth

The primary constraint on high bandwidth availability is an economic one and in Australia this is complicated by the size of the coverage area and our sparse population. Basic infrastructure is an obvious pre-requisite, however technological advances will increase the throughput of what is available today.

Wireless technologies can be expected to benefit from innovations in spectrum usage and the mathematical and hardware improvements that drive higher information spectral density. These allow a higher data throughput through a medium that is constrained by the laws of physics. Fixed technologies, especially those based on optical fibres, can be expected to accommodate massively increased throughput from the greater number of simultaneous wavelengths that can be carried on a single fibre.

Increased bandwidth brings with it a corresponding increase in the quality of the user experience. Most individuals respond in the strongest manner to visual stimuli, thus making the case for basing the user experience on enhanced video content wherever possible. High-definition video and audio significantly increases that experience by allowing body language, facial expressions and voice inflections to be experienced by a human receiver. Bandwidth in the order of a few tens of megabits per second is required to achieve this. While this seems out of reach today, so did today's bandwidth to an observer from even a few years back.

Remote devices

Improvements in remote device capability can be expected to provide increased storage capacity, ability to communicate over a wider variety of media, and improvements in the human interface. One capability that is available today, but we can expect it to be further refined, is the ability to deliver seamless connectivity as users move about. Improvements in wireless technology will allow higher throughput and improved signal survivability in sub-optimal atmospheric conditions.

Devices can be enabled with sensors that monitor the physical environment. Temperature, humidity, lighting and ambient noise are valuable parameters for assessing the suitability of the remote physical environment to the learning experience. Intelligent use of these can be made to adapt the delivery of material in a manner that maximises effectiveness for a given situation (Pahl, 2008).

Most of these enhancements on their own are of little benefit as they need to take advantage of developments in the application layer.

Application layer

Two key requirements of any a remote learning platform are *ubiquity* and *pervasiveness*. Ubiquity is the ease by which a delivery system addresses the time and space gaps that manifest themselves between teacher and pupil. Pervasiveness is the ability of the application to adjust itself to suit the individual learner (Pahl, 2008),

Ubiquity can be expected to improve as the storage capacity of devices improves together with the capabilities of the communications network. Carriers will improve their ability to predict traffic patterns and manage capacity and traffic flows so as to increase the user experience. Similarly, enhanced traffic intelligence will allow better distribution of content so that it can be optimally located where and when it is required. Through a combination of improvements on both the network and user devices, consumers will be able to seamlessly shift between different wireless systems and fixed connectivity. This modular approach to capability can be expected to become more functional as standards are ratified and new entrants into the market increase critical mass.

Perhaps the most impressive gains will be made in the core application itself. The abilities of systems to customise their method of delivery and content to suit the consumer will continue to increase as a function of developments in software engineering and accumulated experience by application developers in content adaptation.

Other enhancements will allow the dimension of physical student behaviour to be factored in. The ability to track eye movement and gazing, similar to that used to monitor vehicle operator alertness, brings in an additional parameter that potentially allows behavioural analysis to take place. Reading patterns, memorisation, distraction and acuity can be used as feedback to modify content and delivery.

Increased use of artificial intelligence will allow the experience gathered from large consumer samples to detect patterns and anomalies that can be used to enhance content, and how it is delivered, while providing better methods for maintaining and enforcing standards. As technology standards develop, it will become possible to build capability in many different parts of the delivery chain, be it at the content layer, in the carrier network or in the user device. The application layer can automatically discover where a particular capability lies, where is the nearest content store, then make a decision on how it should manage the session, which can be optimised for cost, performance or somewhere in between. This is particularly useful as it provides better cost flexibility when commissioning projects with large numbers of end-users. The ability to continue to deliver services even on low-capability devices is an important equity consideration and will open these systems for use in areas that are today considered marginal.

As technology standards develop, it will become possible to build capability in many different parts of the delivery chain, be it at the content layer, in the carrier network or in the user device. The application layer can automatically uncover where a particular capability lies, where the nearest content store may be, then make a decision on how it should manage the session, which can be optimised for cost, performance or somewhere in between. This is particularly useful as it provides better cost flexibility when commissioning projects with large numbers of end-users. The ability to continue to deliver services even on low-capability devices is an important equity consideration and will open up these systems for use in areas that are today considered marginal.

References

Anderson, A. (2008 in-press). Music lessons via satellite. Paper to be presented to ACEC’08, Australian Council for Computers in Education Conference, 29 September – 2 October 2008, Canberra, ACT, Australia.

Devlin, B. (1986). A framework for understanding and dealing with difficult educational contexts. A paper presented at the Technical Working Group Meeting on Training Primary Education Personnel convened by the UNESCO Regional Office for Education in Asia and the Pacific, Chiang Mai, Thailand, August 26 to September 4, 1986.

Moore, D. R. & Lockee, B. (1999). A taxonomy of bandwidth: Considerations and principles to guide practice in the design and delivery of distance education. *Educational Media and Technology Yearbook, 24*, pp. 64-71. Littleton, Colorado: Libraries Unlimited. 168.144.129.112/Articles/A%20Taxonomy%20of%20Bandwidth.rtf (Accessed 3rd June, 2008)

Murray, D. (2003, February 11). New wings for schools of the air. *Sydney Morning Herald*. http://www.smh.com.au/articles/2003/02/08/1044579986662.html (Accessed 4th June, 2008)

Pahl, C. (2007). *Architecture solutions for e-learning systems.* Hershey: IGI Global.

Palloff, R.M. & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom*. San Franciso: Jossey-Bass.

Pelliccione, L. & Albon, R. (2004). Beyond the comfort zone: Using informal mentoring to create lifelines for students in disequilibrium. Paper presented to the ASCILITE Conference in Perth, December 5-8. http://www.ascilite.org.au/conferences/perth04/procs/pelliccione.html (Accessed 3rd June, 2008)

Roblyer, M. & Ekhaml, L. (2000). How interactive are your distance courses? A rubric for assessing interaction in distance learning, *Online Journal of Distance Learning Administration,* 3(2). http://www.westga.edu/%7Edistance/ojdla/summer32/roblyer32.html (Accessed 4th June, 2008)

Shearer, R. (2007). Instructional design and the technologies—An overview. In M.G. Moore (Ed.), *Handbook of distance education* (2nd ed.), pp. 219–232. NJ: Lawrence Erlbaum Associates.

Wagner, E. D. (1997). In support of a functional definition of interaction. *New Directions for Teaching and Learning*, *71*, 19-26.

Relevant web sites

AARNET	www.aarnet.edu.au/Content.aspx?p=103
Alice Springs SOA	www.assoa.nt.edu.au/
Bridgit	bridgitservice.smarttech.com
Dubbo Technology Office	dart.det.nsw.edu.au/html/studios.html
Katherine SOA	www.schools.nt.edu.au/ksa/
REACT	http://shamrock.darwinnt.biz/web/
Onetouch	www.onetouch.com
NT Open Education Centre	www.ntoec.nt.edu.au/
Polycom	www.polycom.com

Appendix 1 Glossary

IDeL/IDL	Interactive Distance e-Learning
NSW DET	NSW Department of Education and Training
NT DEET	Northern Territory Department of Education Employment and Training
SEP	Satellite Education Proram
SOA/SOTA	School Of The Air
VSAT	Very Small Aperture Terminal