Does Geography Shape the Nature of an Educational Innovation?

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This article examines some of the social, technical, and economic issues encountered in the implementation of an educational technology at an Australian regional university. Reference is made to the implementation of the videoconferencing network at Central Queensland University (CQU). In late 1996 when the implementation process was completed the videoconferencing network was unique in universities within Australia. The article, which is based on current doctoral research, explores the reasons for the development of this videoconferencing network and its effect on academic teaching in the videoconferencing environment. The implications of this study for understanding geographical influence on educational innovations are also considered. The geographical isolation of the campuses at CQU helped to shape a unique teaching model using the interactive videoconferencing network.

This article will look at how and why the interactive videoconferencing facilities[1] (IVC) were designed, developed, and implemented for use in teaching undergraduate students located at Central Queensland University's (CQU) five Central Queensland campuses. First, I will set the scene by briefly describing the history of CQU's decision to implement the interactive videoconferencing network. I will then describe the perceived efficiencies and hidden costs of implementing this technology. A framework of teaching and learning theories will be presented, and I will then discuss the role of educational theory in the use of technology for teaching in higher education and describe some examples of how I applied the theory in my teaching. References will be made to the influence geography has had on the implementation and use of the IVC facilities. Not all campuses were treated equally in the design of the facilities. The main campus of CQU is in Rockhampton and the design and implementation of the IVC facilities and staff training were centered on this campus. The article concludes with a discussion of factors to consider when implementing an educational innovation across multiple campuses of a regional university.

Context

Central Queensland University (CQU) is a dynamic, young, multicampus, regional university. It was founded in 1967 as a branch of the University of Queensland. It became a university in its own right in 1991. The main campus is in Rockhampton and it has four satellite campuses in the Central Queensland region: Bundaberg, Emerald, Gladstone,

and Mackay. Prior to 1997 only the Rockhampton campus of CQU taught the full undergraduate programs. At the non-Rockhampton Central Queensland-based campuses of Bundaberg (350 kms to the south), Emerald (260 kms to the west), Gladstone (120 kms to the south), and Mackay (330 kms to the north), only the first year of the undergraduate programs was taught. At these satellite campuses the students watched videotapes of the Rockhampton lectures and usually had a warm body to tutor them at their local campus. After the first year, the students could complete their degrees by moving to Rockhampton, changing to external study, or enrolling in another institution.

In 1995, CQU made a strategic decision that, from 1997, undergraduate students would be able to complete their degrees at their home campus—this was commonly referred to as "Vision '97" (Birch, 1995; Wilson, 1995a). This decision was a proactive response to the large number of students who were opting to transfer to universities based in southeast Queensland, rather than completing their courses at CQU by moving to Rockhampton or by studying in the external mode. To support this initiative of teaching 2nd-, 3rd-, and, where applicable, 4th-year courses at the satellite campuses, the university applied for and received a federal government grant to establish purpose built interactive videoconferencing facilities on all campuses. This would allow students in Bundaberg, Emerald, Gladstone, and Mackay to participate in the Rockhampton-based lectures in real-time. In Rockhampton, the students sit in a classroom with the lecturer, and video and audio facilities capture and send sound and vision to the other campuses where there are students enrolled. The other campuses can also send video

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[1] At CQU, the interactive videoconferencing facilities are referred to as ISL. The acronym stands for Interactive System-wide Learning.

images and sound to Rockhampton or any other campuses that are linked at the same time. This real-time video link up allows the students at campuses other than the originating campus to interact while the lecture is being presented. At the satellite campuses, a local tutor also supports students. In 1997 Bundaberg, Emerald, Gladstone, and Mackay had small numbers of students (< 25) in each class in their 2nd, 3rd, and 4th year. One of the arguments in support of implementing the IVC facilities was that it would allow students at all five campuses to join into one viable class[2].

The implementation of the IVC facilities at CQU in the mid-1990s was unique. To the best of my knowledge there was no other university in Australia that was attempting to teach the bulk of its undergraduate programmes to multiple campuses simultaneously using interactive videoconferencing. Other multicampus universities in Australia that had IVC facilities used them to teach a small number of courses across campuses.

Efficiencies and Costs

From a management point of view the design, implementation, and use of the videoconferencing facilities were promoted as a way of making the teaching of students across campuses more efficient. The videoconferencing facilities were built to support implementation of the Vision '97 policy to allow students at the satellite campuses to complete their degrees at their home campus (Wilson, 1995b), thus reducing student attrition. From the university's perspective the main objectives were to slow down or stop the leakage of students to other universities after completing their first year at CQU and to increase the EFTSU[3] loading at the satellite campuses. The videoconferencing facilities were seen as a method to achieve these objectives by allowing students at the satellite campuses to participate in Rockhampton-based lectures, thereby creating viable class sizes through the establishment of a virtual classroom with students from up to five campuses. Saving money or bringing about new efficiencies are arguments that are often used for implementing a new technology (Sproull & Kiesler, 1991). Most early adopters of technology focus on the efficiency effects of the new technology, but the claims for a more efficient operation are rarely tested.

Owing to the complexities of both the teaching model and the financial systems at CQU, it is virtually impossible to complete a detailed analysis of the costs of conducting an interactive videoconferencing class at CQU. The closest that anyone has come to doing a detailed costing was in a

report to the then Deputy Vice-Chancellor on teaching using the IVC facilities where Bigum and Appleton (1997) found that it cost \$A139 an hour just to run the interactive video-conferencing facilities. This included the costs of salaries for technical staff, maintenance of the IVC equipment, and depreciation of the videoconference bridge. It did not include the cost of outfitting the rooms or the costs of the links among the campuses or a proportion of the cost of the academics' salaries. This report also identified that there were hidden costs associated with teaching staff having to adapt their material to this format (Bigum & Appleton, 1997).

Thus the argument for implementing the IVC facilities for efficiency and economic reasons was never confirmed by investigating the total costs of setting up, running, and maintaining the facilities and the extra hidden costs associated with teaching via IVC. This process would have been assisted if the university had conducted a needs analysis followed by a full-cost benefit analysis. At CQU it is difficult to determine exactly how much it costs to teach a class using the IVC facilities owing to the complexities of the teaching model used by the university and the use of a generic financial system, PeopleSoft Financials. PeopleSoft Financials was not designed to be able to separate the costs of the IVC infrastructure into a cost per campus or a cost per class. Costing out the staffing is also difficult as the only staff employed solely to work on the IVC facilities are some of the technical staff. For other staff, academics and general, working with the IVC facilities is only a part of their work role and it would be very difficult to account for the amount of time devoted to using the IVC facilities.

Teaching and Learning Theories and Educational Technologies

In any form of teaching, the teacher has a model of learning that she uses to plan her teaching. This model may be implicit; in fact, the teacher may not even be aware of it herself. In this section I will explore the relationship between theories of learning and educational technology. I will discuss how educational theories have influenced the use of educational technology for teaching and learning in higher education.

Since the early 1990s there has been a movement toward a sociocultural theory of learning, which looks at the role of social interaction in learning and emphasizes the role of language and therefore dialogue. This theory is principally based on the work of Vygotsky. Jones and Mercer (1993) have given a broad account of the implications of this theory for educational technology.

Another development late in the 20th century was to use a phenomenographical methodology to generate a teaching strategy. Phenomenography uses descriptions of how students experience learning to provide an empirical base that can inform an approach to teaching. The research describes

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[2] Emerald is a very small campus. In 2003 very few IVC classes connected to Emerald.

[3] Effective Full-time Student Unit (ETTSU) is a method that the Federal Government in Australia uses to measure student load at universities.

the types of interaction that must take place among teacher, student, and content (Laurillard, 2002). Marton and Booth (1997) discuss ways in which phenomenography can contribute to better learning. They define a pedagogy in which "teachers mould experiences for their students with the aim of bringing about learning, and the essential feature is that the *teacher takes the part of the learner"* (p. 179; emphasis in original). Laurillard (1993, 2002) has written a seminal work on university teaching that describes how to use what we know about the characteristics of student learning (derived from phenomenographically based research) to generate a teaching strategy for the effective use of educational technologies.

Theory in the way I am using the term, either implicitly or explicitly, informs policy and practice in the use of various technologies deployed to support teaching and learning in higher education. Theory should explain how a particular example of teaching material and/or a teaching strategy could be expected to contribute to the students' learning experience (Issroff & Scanlon, 2002). The influences of the latter part of the 20th century and the beginning of the 21st century highlight the importance of social, cultural, and contextual perspectives when analyzing teaching and learning materials and strategies.

Laurillard (2002) states that "academic learning has a second order character, as it concerns descriptions of the world[, w]hereas natural environments afford learning of percepts through situated cognition" (p. 23). Therefore university teaching must create artificial environments that provide opportunities for the students to learn about the world. The bulk of educational research that emphasizes the situated nature of learning does so in relation to the content rather than the context. Laurillard (2002) argues that "the absence of research on the context of learning gives us an over-simplified view of student learning" (p. 63). Therefore it is important that the teacher understands the context of student learning when designing teaching and learning materials and strategies.

The link between educational theory and the design, implementation and use of educational technology is actually very frail but for a few researchers such as Laurillard (1993, 2002). CQU's implementation of its IVC facilities was a situation where the key decision makers did not refer to educational theory when they designed the IVC rooms. The senior management at CQU emphasized that the introduction of the IVC facilities for teaching would have no effect on academics' teaching. They said that it was the same as teaching face-to-face, except that they would be in front of cameras and students from other campuses would

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be able to join in the lecture in real-time[4]. A review of the literature available at that time would have shown that using the IVC for teaching is very different from teaching face-to-face (Comeaux, 1995; Egido, 1988; MacKinnon, Walshe, Cummings, & Velonis, 1995).

At CQU the decisions made with respect to the design and implementation of the IVC network were based on a review of other IVC networks such as that built by the Technical and Further Education (TAFE) sector in South Australia. The rooms were designed to resemble normal classrooms with the addition of technology such as cameras, television monitors, and microphones. The assumption was that these rooms would be used to teach only in a didactic manner with the lecturer at the front of the room giving a traditional lecture. Literature available at the time would have revealed that IVC is best used for interactive classes (Cloke, Farren, & Barrington, 1996; MacKinnon et al., 1995), not traditional, didactic lectures.

Comeaux (1995) found that IVC was best used for small classes which allow lecturers and students to be very interactive. Yet one of the rooms at CQU was designed to seat 135 students. Having a class this size and connecting to three other campuses creates a large class (approximately 200 students), which makes it very difficult to run an interactive class.

I do not know why the decision-making staff did not refer to current literature on the use of videoconferencing for teaching and learning when they were designing the network. In an interview the then Pro-Vice-Chancellor (Academic and Research) stated that "it was all done wrong: we imposed the technology . . . before we realised what we were going to do with it" (Goulter, 1997). He also stated that they decided to place an emphasis on visiting existing videoconferencing sites in Australia and adapting the traditional face-to-face model of teaching to the new medium because most lecturers were "content-driven." Hence they based their decisions on what they saw during site visits and the model of teaching with which they were most familiar. They ignored the recommendations of an external evaluator's report of the early use of IVC at CQU for teaching and learning (Mitchell, 1993a). As I discuss below, this might be understandable, but it does not promote a firm foundation for developing and implementing an educational innovation.

I will now give a brief overview of videoconferencing in higher education in Australia before discussing how I have applied what I have learnt from educational theories to teaching my own classes using the interactive videoconferencing network.

Videoconferencing in Higher Education in Australia

Videoconferencing, marketed as the "picture telephone," was publicly released by Bell laboratories at the 1964 World Fair (Egido, 1988, p. 14). The first known use of videocon-

ferencing for teaching in higher education was in the United States, where in 1974 "Northwestern University began to test applications of slowscan video for instruction heralding a new era for educational telecommunications" (Mitchell, 1993b, p. 95). The first use of videoconferencing at a university in Australia was "the University of New England's pioneering trials between Armidale and Coffs Harbour for ten days in October 1989" (Mitchell, 1993b, p. 4).

There have been very few critical analyses of the process of teaching using interactive videoconferencing. Most studies compare videoconferencing with face-to-face lecturing. Researchers seem delighted if they can demonstrate that teaching by videoconferencing is as good as face-to-face teaching or that there are no significant differences in the results for students taught by videoconferencing and those taught face-to-face (Bates, 1995).

A literature search of Australian education journals for uses of interactive videoconferencing in higher education in Australia revealed several case studies of trials using videoconferencing (for example, Hansford & Baker, 1990; Knox, 1997; Latchem & Rapley, 1992; Treagust, Waldrip, & Horley, 1993). These studies tend to describe what they observed or compare student results or the student responses to a survey. None of these studies attempted to analyze the pedagogical use of interactive videoconferencing as a new model of teaching. Some studies (such as Branch & Tonkin, 1997) just describe the technology itself. In this respect the literature on interactive videoconferencing is similar to literature in the area of other new technologies, such as computers.

One paper that focused on the teacher's approach to teaching and learning was by Jamieson and Martin (1997). They conclude that research into the use of new educational technologies should focus on the critical relationship between a teacher's previous experience of, and approach to, teaching and learning rather than on the teacher–technology relationship, which has dominated previous research.

The bulk of the research articles on the use of IVC for teaching and learning focus on comparing teaching using IVC with face-to-face teaching. This implies that the best way to use this new technology is to replicate what already exists. Another approach to implementing this technology would be to think of ways to use the innovation to support something one could not do in a normal classroom. For example, one could arrange for an expert in another city, or country, to give a guest lecture via videoconference. This would be a huge advantage for staff and students living in an isolated city like Rockhampton where access to experts in a discipline area is very limited.

Applying the Theory to Practice

In Laurillard's (1993, 2002) principled approach to generating a teaching strategy, the emphasis is on the types of interaction that must take place among teacher, student, and content. Using the approach described by Laurillard, three other members of a teaching team and I redesigned the teaching strategies and assessment used in a course taught via the IVC facilities. In order to increase the interaction between the lecturing staff and students at the four campuses, the presentation of key concepts through student seminars was introduced. Each week a group of students was asked to select one or two key concepts from that week's content and to describe these concepts to their peers. This presentation formed part of the assessment for the course. To encourage the presenters to generate discussion amongst the class, marks were allocated for interaction. Most students generated discussion by having a question and answer session at the end of their presentation. Some of their methods were quite inventive. One group used a game based on Celebrity Squares where nine faces were presented, and the audience was asked to select a face. Each face had a question behind it, and the audience had to answer the question. Each week, after the student seminar, the staff would summarize the main points that had been discussed and encourage discussion of any aspects of the coursework that the students felt needed more clarification; thus interaction occurred among teacher, student, and content each week.

At the end of the term, there was a feeling in the class that the students and staff all got to know one another well even though each campus was geographically isolated from the others. There was even a case of public flirting when, during question time, a male student in Mackay asked for the telephone number of a female student in Gladstone!

Changing the teaching strategy in this course was difficult, as it required staff and students to adjust to the learning environment. The teaching staff placed a lot of emphasis on helping students to adjust to the new teaching strategy. At the beginning of term, there were several workshops where students were taught how to prepare visual materials for their presentations and were given several opportunities to practice using the IVC facilities before they had to present their seminars. Overall, the students were very positive in their anonymous end-of-term evaluations of this course.

The Influence of Geography

In the context section above, the implementation of the IVC facilities at CQU was described as unique in Australia because no other university in Australia was attempting to teach the bulk of its undergraduate programmes to multiple campuses simultaneously using IVC. Most other multi-campus universities in Australia run separate undergraduate programs at each campus, or lecturers at metropolitan universities travel to the other campuses and repeat their lectures at each campus as the distances between campuses are not as great as at CQU (up to 350 kms). Those universities that have installed IVC facilities use them to teach a

small number of courses across campuses or for specialist programs. At CQU only the Gladstone campus is close enough for a staff member to commute to and from it in a day from Rockhampton. The large distances between campuses meant that other options for teaching to most or all campuses had to be explored. A distributed IVC facility was seen as the best option because it allowed staff to teach to several campuses simultaneously.

To prepare staff for teaching using this technology there were some seminars given at the Rockhampton campus. At these seminars the presenters mainly talked about the technology itself; for example, the signals are sent between sites using a compression algorithm, and they gave handy hints as to the font sizes and colours to use when preparing PowerPoint slides. There were no hands-on workshops or opportunities for people to present minilessons and receive constructive feedback. The technology was not demonstrated except for actions like displaying a picture of the keypad on the large screen and the presenter describing what happened when each button was pushed. Though we were in the IVC room at the time, the room was being used as a traditional classroom.

The campuses in Bundaberg, Gladstone, and Mackay had very little, if any, training in the use of the IVC facilities. In Mackay one of the early users of the system was given a 5-minute briefing on how to use the technology by one of the general office staff. He also recalled that an educational designer from the Rockhampton campus presented a seminar on how to prepare PowerPoint slides for use with the IVC facilities. The problem was that the Mackay IVC site was set up as a receiving site, not as a teaching site, so there was no computer in the IVC classroom for staff to use to present teaching material to other sites (Rod Jewell, personal communication, December 5, 2002). At the Bundaberg campus there was some assistance given by the Information Technology Division (ITD) staff on the use of the technology itself. The ITD staff at this campus saw the need for more training and developed their own in-house training workshops for staff and for students (Angelika Schlotzer, personal communication, November 29, 2002). At the Gladstone campus, which is the second smallest campus of CQU, there was a perception that no training was available. An early user of the IVC facilities recalls being given the key to the room and having to learn to use the facilities herself during her first videoconference (Maria Madsen, personal communication, November 25, 2002)[5].

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[5] I could not find any data for the Emerald campus, as there are no staff still working there who started pre-1997. As noted above, Emerald is a very small campus, and the space it occupies is shared with the local Institute of TAFE (Technical and Further Education). To the best of my knowledge, there is no central register of staff training in the use of the IVC facilities at CQU.

In response to the very limited training when the IVC facilities were first implemented, some of the users experimented with different techniques and teaching strategies until they found a way of teaching that matched their content areas and teaching styles. They were constrained by the decisions made before implementation because the videoconferencing rooms were designed and built to replicate a tiered classroom such as those used for face-to-face teaching with the addition of cameras, microphones, and television monitors. The more innovative lecturers found themselves constrained by the fixed nature of the furniture in the videoconferencing rooms. Other lecturers did not adjust their teaching strategies at all, while some rejected the technology altogether.

When the IVC facilities at CQU were implemented, it was envisaged that they would be used for teaching a distributed class, where the bulk of the students would be located in Rockhampton, and smaller classes would be located at up to four remote sites: Bundaberg, Emerald, Gladstone, and Mackay. Little thought was given as to how this would affect other sections of the university. For example, one thing that was not predicted was that this teaching model would dictate that the class timetables for all Central Queensland campuses would have to be linked to allow staff to book rooms at up to five sites simultaneously, and that the bookings for the IVC timeslots in the timetable would have to be completed before the remainder of the timetable could be finalized at each of those campuses.

Australia is a large continent (similar in size to the United States) with a very small population (approximately 20 million). Queensland's population is the most distributed of all the states and territories in Australia (see also Moriarty, Danaher, & Danaher, 2003). Travel takes time and is expensive. The university needed to look at cost-effective ways of teaching across the dispersed campuses that make up CQU. The implementation of the IVC facilities was one method of solving the dilemma of teaching such a geographically dispersed student population in real-time. At the same time, that geographical dispersal helped to shape the design and implementation of those facilities.

Conclusions (or How Not to Implement an Innovation in Educational Technology)

In conclusion, the implementation of the IVC facilities at CQU has been successful because 7 years after implementation they are being used for over 100 hours of teaching per week. This is despite the problems outlined here:

- The economic reasons for deciding to implement educational technologies were not tested.

- The technology was implemented without reference to educational theories or research on the use of IVC for teaching and learning.

- There were problems with linking to other university systems, for example, trying to link room timetables on five separate campuses in order to be able to book an IVC session.

- The staff training was very Rockhampton-centric.

The academic and technical staff have worked together to overcome these problems and to legitimize the use of the IVC facilities for teaching at CQU. The initial Rockhampton-centric view of the IVC technology has changed considerably over time. In 2003 at least some staff members at all Central Queensland campuses conducted lectures using these facilities.

Not referring to existing literature on the use of IVC facilities for teaching in higher education did cause considerable problems and complications for staff and students. Yet, despite this, the facilities are still being used extensively for teaching and learning as well as staff meetings and seminars. Australians as a nation are used to overcoming obstacles and adapting to new and changing situations (see also Moriarty, Danaher, & Danaher, 2003). Australia's geographical isolation, huge land mass, and small population have meant that we have had to follow the boy scout motto of "adapt, innovate, or overcome" with respect to our use of technologies to assist us in our educational provision.

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