CHAPTER FOUR

Cautiously Optimistic: the work associated with on-line university teaching

Leonie Rowan

Abstract

Contemporary educational, economic, technological and equity pressures have given rise to a veritable flood of 'innovative' university teaching practices ostensibly designed to make teaching at once more effective, more efficient and more attractive to the student population. While the existence of these teaching innovations is easily documented and while many are celebrated uncritically—and optimistically—for their 'innovative' and 'flexible' nature, there is an absence of research focused on the actual and ongoing work (including significant technological, political, social, ethical and economic negotiations) required to make any educational innovation durable and stable.

This paper reports on research within a current Australian Research Council Large Grant project that is designed to explore and document the actual work required to make university teaching innovations stable and durable. Drawing on the analytical resources provided by the sociology of translation (actor-network theory: ANT) and focusing on a particular instance of web-based university teaching within a Queensland university, this paper explores the usefulness of ANT for identifying the full range of influences, pressures and contexts (social and technical) which shape the design, development, implementation and, potentially, the stabilisation of educational innovations. The paper explores the way ANT based educational research can help us translate optimistic teaching goals into sustainable teaching practices.

Introduction

Whether or not they are influenced by contemporary educational, economic, technological and equity debates, it is possible to identify among increasing numbers of university academics a firm belief that they need to teach in fundamentally new ways. In some cases this is attached to a perceived imperative to be more 'innovative' and more 'efficient' in their educational practice in order to attract and retain students, to meet the demands of an increasingly diverse student population and to contribute to a university's cost-effectiveness. It is possible to argue that this kind of logic has given rise to a veritable flood of 'innovative' teaching practices, many of which are supported by substantial funding from Commonwealth agencies and university teaching development grants, and through institutional infrastructure (e.g., 'smart' lecture theatres that incorporate computer displays, visualisers and overhead projectors into their display mechanisms). While many instances of 'innovation' are celebrated uncritically for their 'innovative' and 'flexible' nature—and while there is no shortage of papers written about such educational innovations as on-line learning and its associated pedagogical practices—there is an absence of research focused on the actual and ongoing work required to make any educational innovation durable. As Laurillard (1993, p. 8) notes, "Research and development projects on educational media pay quantities of hard cash for development, lip-service to evaluation, and no attention to implementation."

In response to this situation, this paper reports on the early stages of a research project funded by an ARC large grant for 2000/2001[1]. Titled *Investigating On-line Learning in Higher Education Settings: An Actor-Network Approach*, the project has three specific goals:

- to identify the full range of influences, pressures and contexts (social and technical) which shape the initial design, development and implementation of an educational innovation.
- to map in detail the full range of influences, pressures and contexts (social and technical) which determine the ongoing work required to ensure the stabilisation of an innovation.
- to develop a comprehensive framework by which on-line teaching and learning innovations can be assessed as to their ability to successfully negotiate with the full array of complex influences identified in this research.

This paper reports on progress we have made to date towards these objectives via reference to the first of three site studies. The paper is divided into four main sections: in the first I will acknowledge briefly the context that works to encourage a plethora of technologically based teaching innovations; in the second I will highlight the issues left largely unexplored within a generally self-celebratory pro-technology discourse; in the third and fourth sections I will outline the way in which the ARC project identified above makes use of actor-network theory (ANT) to try and move beyond the uncritical celebration of on-line learning practices towards a more holistic understanding of the work, work, work, associated with the adoption and stabilisation of any instance of on-line teaching.

Part One: The Context

As indicated above, the ARC project is based on an awareness that academic staff within universities are increasingly required to respond to several (often competing) sets of pressures through the development and implementation of educational programs. First, changing

economic conditions associated with the emergence of a 'global economy' contribute to a financial context within which universities are now expected to compete actively for students; to develop niche marketing opportunities; to 'capture' international markets and, above all else, to be economically efficient and competitive in a broadening 'global' market base (Carnoy, Castells, Cohen, & Cardoso, 1993; Castells, 1996; Emy, 1993; Gee, Hull, & Lankshear, 1996; Kenway, Bigum, & Fitzclarence, 1993).

Second, educators operate in a context which is characterised by a broad and uncritical take up of new technologies. Australia enjoys a reputation for rapid and uncritical adoption of new technologies. Be it colour television, mobile telephones, personal computers or Internet use, Australia appears at the top of most analyses comparing consumption rates for these items with rates in other countries. In this context the association between computers and learning has been made strongly and unproblematically (Bigum, Green, Fitzclarence, & Kenway, 1993).

Third, recent years have raised public awareness of issues associated with access and equity, particularly in relation to factors such as gender, race, class, ethnicity and physical ability. In educational contexts, this has given rise to an increased awareness of the diversity of the student population and at least some acceptance of the importance of recognising and responding to this diversity in relation to the design, content, assessment and delivery methods of educational programs (Rowan & Bigum, 1997). In this context technologies are often represented as rather magical solutions to the extraordinarily complex and multi-dimensional equity problems associated with student access to staff and/or information. This is particularly the case for students who have disabilities or live in rural and remote

areas: through various forms of technology they can (at least theoretically) enjoy access to resources that they otherwise would not have been able to use (Atkinson & et al., 1995). More often than not, 'technology' and 'equity' are used together in university discourse to emphasise the ability of technologies to improve 'client services' and thus to enhance the marketability of a particular institution.

Together and individually, these contexts have helped to develop powerful mindsets relating to technology and its place within universities. While lip service is still paid to equity or social justice agendas, it is not difficult to argue that the current rush to 'go on-line' is motivated more by the widely held (and generally unproblematised belief) that to 'technologise' a curriculum is to automatically make it 'better' and 'more efficient'. In economic terms, technological responses are particularly appealing for two key reasons: first, they offers ways of delivering educational programs consistent with a shift from face-to-face teaching to off-campus, or distributed teaching (that is, teaching across multiple campuses and sites). This has significant financial appeal as it (theoretically at least) allows one academic (or academic team) to be responsible for students distributed throughout Australia and, increasingly, overseas. Second, an ability to deliver programs to students located at a distance has the potential to improve student numbers without necessitating the establishment of costly branch/satellite campuses.

What I am trying to emphasise here is that increasingly serious economic conditions have helped to encourage the search for technologically mediated and economically efficient solutions to the financial challenges negotiated by universities. This pro-technology mindset is, of course, consistent with a fundamental tenet of post-industrial economically rationalist society which is in many ways based

on an uncritical belief in technical solutions to economic problems. T. Luke (1988, p. 40) summarises the situation well when he writes:

> With the passage of time, most universities change. Some will counter the tide of neo-liberal cost-cutting and find the friends and funds out in society to continue their time-tested and self-directed course toward greatness. Many others, however, must face the hard realities of less financial support, diminished public backing, and fewer special prerogatives. In this environment, the techno-fix of the virtual university is thought by many to provide a single solution for many problems.

A major focus for many of these technologically driven initiatives is on-line learning, that is using the Internet and most commonly the World-Wide-Web (WWW) to deliver materials and provide interactions between teaching staff and students and between students as a group. An indication of the interest in developing such courses is provided by Robson (1999) who has estimated that globally, the number of web-based courses is doubling every eleven months. Australian universities are clearly contributing to this growth with virtually all of them placing some of their courses online. What 'putting a course online' actually means in practice varies significantly from course to course and institution to institution. Practices range from putting lecture notes and study guides onto web pages all the way through to interactive on-line teaching systems which provide discussion groups, email lists, electronic submission of assessment, and either 'automated' feedback on electronic tests, or electronically communicated feedback on assignments.

As I indicated above, there is generally no shortage of *information* relating to these on-line courses available. Universities are quick to point to evidence that they have a

'technologically informed' or 'cutting edge' curriculum. As was the case when computers first began to be used for educational purposes, the lemming-like rush to 'go on line' has been characterised more by anxieties to keep up or catch up with competitors (particularly overseas) than by any detailed assessment of or reflection upon either the economic or the educational merits of the programs that have resulted (Bigum, Fitzclarence, Kenway, Collier, & Croker, 1993).

As a result there are four particular issues in the literature that I would like to highlight here. These are not, I hasten to add, the only questions that can or should be asked with regard to the pro-technology discourse driving much university practice but they are four issues that have helped to shape the design and conduct of the ARC project which this paper reports, and, as such, are important to acknowledge specifically.

Part Two: Some Issues

First, the incautious 'technofix' attitude identified earlier regularly fails to acknowledge the nature and amount of work associated with the design and development and, importantly, the maintenance of an innovation. Such an attitude can also fail to recognise the high cost of the (common) investment in technological innovations which do not ultimately negotiate their environment and are either rejected or radically redesigned.

Second, within many university environments technology is associated unproblematically with innovation. A simple syllogism operates here: "Technology is innovative; I am using technology in my teaching therefore I am being innovative". The current economic context encourages this association. Jesson (1998, p. 96) argues that "Academia has

given birth to and uncritically embraced virtual technologies" with some of the more common "techno-fixes" being based on the use of e-mail, the world wide web, video-conferencing, computer mediated learning and on-line teaching. In recent years, the development of software to help academics publish their course materials has seen on-line teaching become an increasingly common educational practice.

It is in response to these first two issues that a third problem arises: there is a common tendency for academic-innovators to respond only to the more *overt* economic or technological agendas discussed above and to neglect other significant contextual issues. This leads to a situation where innovations risk rejection by people or things who have stronger allegiances to other agendas. For example, even the most pedagogically competent academic may ultimately reject a technologically-based innovation if—in its actualisation—the innovation is not consistent with their educational values or beliefs. Alternatively, academics may be caught up in a trend towards 'techno-fixes', and fail to attend to the important role of other key players in determining the 'success' of an innovation. In other words, they may neglect to recognise the importance of crafting alliances with other people and thereby endanger the stability of their innovation.

One example here illustrates the fourth challenge that we identify in relation to dominant mindsets associated with technological innovation in universities. While emphasis is continually placed upon the economic reasons for going 'on-line' and while the rise and rise of on-line learning appears to demonstrate that this is an attractive 'market place' option, women and men are routinely positioned in different kinds of relationships with technology, innovation *and* on-line learning. Despite being widely acknowledged within feminist literature, this point is rarely acknowledged

within the kind of unproblematically celebratory discourses identified so far. The point I wish to make is that neither the technologies that are used to underpin these innovations, nor the environment which produces, endorses and maintains them, nor, indeed, the courses they are most commonly associated with are 'gender neutral' in any sense. This means that men and women may face quite different challenges in their attempts to introduce, manage and stabilise a technologically based innovation.

Helping to obscure consideration of all of these issues is the absence of research that demonstrates in specific detail the nature and the amount of work that is associated with putting an innovation in place. This work involves more than just the technical and educational labour associated with developing on-line materials and includes all of the political, social, ethical and economic negotiations associated with developing, implementing and maintaining any innovation (Latour, 1996): negotiations which vary considerably depending upon the gender of the key people involved.

The research project that this paper reports is designed to address this absence and in the next section of this paper I would like to outline the framework and resources that we draw on to make the move from uncritical descriptions or overly optimistic celebrations of technologically based innovation to more cautiously optimistic—and ultimately more useful—studies of these projects.

Part Three: Actor-Network Theory and the Study of Innovation

In order to begin to address the issues raised in the previous sections, educators need access to a framework for analysing educational innovation that is able to take account of the full range of factors influencing the design,

adoption and implementation of these teaching practices. This framework needs to attend to both the diverse set of people who impact upon any innovation and the diverse objects and/or technologies which must be woven into any innovation. In addition to this, the kind of framework we are working towards needs also to acknowledge that an innovation becomes stable (and thus durable) only when it can be seen to have successfully negotiated the often competing agendas of all the members of a network.

In other words, we are working throughout this ARC project to articulate an approach to the study of technological innovation that is able to map the negotiated relationships between *all* of the members (actors) within a socio-technical network and thus determine the process through which a network is ultimately stabilised (or made durable). Actor-network theory (ANT) has strong credentials for this kind of study of technological innovations (Callon, 1986a; Callon, 1986b; Latour, 1991; Latour, 1996; Law, 1992) and offers the prospect of an holistic theoretical framing of teaching innovations in education, particularly those employing computer technologies (Gilding, 1997; Rowan & Bigum, 1997). ANT is well positioned to acknowledge the complexity of innovation because it denies the existence of purely social or purely technical relations arguing for a *sociotechnical* approach (Callon & Latour, 1981; Hughes, 1983; Latour, 1986) to technological innovations.

To address the need to treat both human and non-human actors fairly and in the same way, ANT is based upon three principles: agnosticism, generalised symmetry and free association (Callon, 1986b). The first of these tenets, agnosticism, means that analytical impartiality is demanded towards all the actors involved in the project under consideration, whether they be human or non-human.

Generalised symmetry offers to explain the conflicting viewpoints of different actors in the same terms by use of an abstract and neutral vocabulary that works the same way for human and non-human actors. Neither the social nor the technical elements in these 'heterogeneous networks'(Law, 1992) should then be given any special explanatory status. Finally, the principle of free association requires the elimination and abandonment of all a priori distinctions between the technological or natural, and the social (Callon, 1986b; Singleton & Michael, 1993).

Within the framework of actor-network theory, then, studies of educational innovation are far more detailed, and rich, than many more traditional studies. The methodological dictum of ANT—follow the actors (Callon, 1986c; Callon, 1991; Latour, 1996)—is paramount. In asking questions of the people, materials, and technologies of an innovation (Cooper & Law, 1995; Law, 1994) framings of the study are determined by the actors, not by the investigators' existing assumptions. Thus an ANT study involves following the leads suggested by the initial set of actors, akin to the way a detective investigates a murder. This process leads to the development of a complex and holistic picture of the processes through which any innovation is introduced, negotiated and stabilised.

As a framework for thinking about and studying educational innovation, therefore, ANT begins with the acknowledgment that the process of successfully introducing and stabilising an innovation involves the construction of a heterogenous network of relationships—an assemblage—between various human and non-human actors and the 'shoring up' of relationships between these actors so that the network stays in place and operates in the desired way, with minimal attention or policing from those who desire it in the first place.

Several further points follow:

- as identified earlier, each network involves an assemblage of people and things—human and non-human or linguistic and non-linguistic actors—all of whom have an impact upon the operation of the network. An actor, or actant, is an abstraction that assists in the analysis of situations involving heterogeneous entities (Law, 1992). The important thing about these actors is that they must be able to make their presence individually felt (Law, 1992). If they exert no noticeable effect or they make no difference, then it is not necessary to acknowledge their existence
- generally speaking, the more of these actors attached to any network, the more 'real' the innovation becomes; the harder it is to disassemble; the more stable and durable it becomes
- all of the identified actors in a network continually re-negotiate one another's roles in a move/counter-move process
- this means that the key person at the centre of a network—the person often charged with responsibility for the idea or innovation—is always involved in trying to stabilise the network. This involves attempts to convince other actors that they should perform the roles that the innovation has assigned to or negotiated with them

This brings us, of course, to the title of the paper—work, work, work. The person at the centre of an innovation does much more than come up with a good idea, put a few things in place, and then stand back and watch while everything develops according to some 'master' plan. Despite the celebratory nature of technological discourses (and the kinds of publicity that are found within most universities) every

innovation can be read as a network that has to be continually maintained and policed. All of the individuals within each socio-technical network continually re-negotiate their roles and the ANT framework we are applying to the analysis of web-based teaching is interested in what actors do to assign roles or ways of behaving to other members of the network. These roles are not predetermined by any single actor but arise through a process of negotiation. A useful image here is provided by Bruno Latour who talks about the development of socio-technical projects or innovations as akin to playing scrabble. The tiles you play depend on what others have played on the board (Latour, 1993, p. 99-100).

This brings us to the data that we would like to examine in the final section of the paper. We will begin with a brief overview of the specific site—and the key individual driving the innovation—and then go on to emphasise the way in which the appearance of stability associated with the innovation can work to obscure the amount and the type of work associated with achieving this stability.

Part Four: Work, Work, Work: An ANT Analysis of an Innovation

As mentioned earlier, The ARC project that this paper is based upon involves three site studies[2]. The first of these studies, which we report here, is focused on an advanced (i.e., second/third year) undergraduate computing course—which we will call *Computer Systems*—being offered in a regional, post-Dawkins university. The course which is offered in both 'internal'/on-campus and external mode, began with relatively small student numbers but has grown significantly during the period from 1996 to 1999 when the course has been moved to and taught 'on-line'.

The lecturer in charge of this unit—Daniel—first began to experiment with teaching on-line in 1992 when he began to use mailing lists to supplement his lectures and tutorials. Since that time he has added more and more people and things to his innovation or heterogenous assemblage that can be known as "the on-line delivery of *Computer Systems*". He developed his own open architecture system to support the publication of web pages for teaching—a system he also made available to other staff.

An indication of the increasingly large number of actors in the assemblage is provided by the following table:

	1996	1999
Teaching terms (in weeks)	2 x 13	2x12 & 2x6 or 3x12
Students	77: 20 @ 1 campus 57 distance	168: 47 @ 5 campuses; 121 distance
Staff	Lecturer, marker	Lecturer, 2 campus lecturers, 3 tutors, marker
Course offered	Once a year	Twice a year
Assessment	2 assignments & final exam	6 assignments
Access to CD ROM	91% of students	Almost all
Access to Internet	74% of students	Almost all
Construction of website	By hand – with primitive	With Lecturer's home grown editor web page development software
Size of web site	60Mb	1024 Mb
Number of files on website	5430	11097

This table gives some indication of the amount of 'stuff' attached to the heterogenous assemblage. It does not, however, necessarily indicate the ways in which many of these additions are the result of on-going attempt to get some of the key actors in the assemblage—the students—to carry out the role that Daniel wished to assign to them.

In seeking to apply the ANT framework outlined above to the analysis of Daniel's innovation, we have analysed several data sources. In this paper we are drawing particularly upon student evaluations completed between 1996 and 1999 (and often submitted electronically); other instances of student feedback, 3 semi-structured interviews conducted with Daniel during 2000 as well as more than a dozen 'observations' or interactions during the same period. Use has also been made of various artefacts such as the course website, CD-ROM, and course study-guide; Daniel's own notes and publications relating to the course; and a range of formal or informal notes from students.

It is important to acknowledge here that while the ANT framework demands attention to the roles of both human and non-human actants, it is methodologically challenging to actually interview a computer, or a printer, for example. In the following examples the technological actants speak are represented primarily through the words of the students, but close attention to the comments being made indicate that they have provided Daniel with a very challenging environment.

In other words, where innovations are seen to involve negotiations between humans and non-humans then we can pick up what the non-humans are "saying" by attending to human responses and negotiations.

The three examples that we refer to here—placing study materials/text books on line; making use of email discussion lists and discontinuing face-to-face lectures—are all relatively common occurrences in on-line teaching contexts. They are commonly cited at this particular university as examples of what 'on-line learning' has to offer. Indeed, it is possible to argue that all of them are as synonymous with on-line learning, as lectures and tutorials are with face-to-face teaching. Despite this, none of these elements of Daniel's

on-line innovations fitted simply or unproblematically into the existing assemblage involving himself, the students and their respective computers. Instead, Daniel and his students (and their computers/printers etc) have re-negotiated their roles in an on-going fashion.

Putting study materials on line

In 1996 and 1997 the text for the course—approximately 300 pages long—was distributed via the Web to on-campus and distance students. This circumstance arose because of problems in preparing the material for print production in time for the university unit which distributed the materials to students. It was clearly a less expensive way for the university to deliver the materials and one that is sometimes promoted as a benefit of web-based teaching.

Students—and their printers—objected. As two students commented:

> *I have no printer, so another student with access from work prints and photocopies notes and sends to me.*
>
> *I didn't want to spend 24 hours a week printing them out on a 9-pin dot matrix printer.*

The inconvenience of having to print out one's own course notes was exacerbated in some cases by concerns about the cost of actually accessing on-line material. A course that is so reliant on on-line access by students requires good quality and inexpensive access to the Internet. The institution at which the course was offered, like many other in Australia, had downgraded the service it offers students with a view to encouraging them to use commercial Internet providers. This adds a cost to any student doing the course which can limit their use of web-based materials. As one student commented:

The major problem I have is not having access to the study material without having access to my computer or spending considerable time and money to down load and print all of the study material available of the subject home pages.

As a result of this strongly articulated student dissatisfaction, course notes were distributed in hard copy. This involved Daniel in more work, particularly that associated with meeting the formatting and presentation guidelines of the university's external material centre to deadlines that often seem quite bizarre: material to be despatched in March, for example, needs to be submitted in September of the previous year.

In addition to this, in 1998, the course offered students a CD-ROM mirror of the web site. The CD-ROM allowed fast access to large files and removed the concern about costs in being on-line for long periods of time. The lecturer had to establish for himself the infrastructure to enable routine mirroring of the website to CD-ROM. This has met with student approval as one person comments:

I think the CD-ROM is a good idea as I could not have used the resources to the full extent if I had to do it online.

Nevertheless, students still complained about the fact that they have to buy the CD, a situation which has arisen because Daniel—despite his technological competence and international credibility—has been unable to enrol in his network those people who distribute university resources to support the development of these materials in his own network. He had to arrange, instead, for his CD Rom to be printed by an external company, and therefore charges students to recover costs.

At the present time therefore, students enrolled in *Computer Systems* have access to hard copies of a text book/study guide, a web site and a CD Rom mirror of the web site. In other words, in order to get the students to perform their roles as students, Daniel had to change the provision of material three times. His responses have been impacted upon not just by the students, but by the technological actors, for the costs, capacities and 'user-friendliness' of various technological options all shaped Daniel's attempts to respond to student demand. In other words, he was not able to simply come up with a magical solution: instead he had to negotiate the demands and characteristics of the humans and the non-humans in his network; to meet the interests of all members of the network: machines, software, students, administrative systems and so on.

Similar levels of negotiation were required in relation to Daniel's decision to abolish face-to-face lectures which I will look briefly at now.

No lectures delivered on-campus

The move to rely on on-line study materials and weekly tutorials was intended to reduce problems of consistency that had arisen from having different lecturers teaching at different sites (bearing in mind that the course was offered at a range of campuses, many of which were staffed by casual or part-time lecturers). During the 1996, 1997 and 1998 offerings of the course there were no lectures for on-campus students.

The student reaction was mixed, with some students stating emphatically that the course did in fact "need lectures" and others arguing that they liked "the idea of not attending lectures [because] everything can be read off the computer screen and having a [email-based] discussion group is far better than a lecture".

Interesting, from an ANT perspective, many others took the no lectures position as an opening move and started negotiating for alternatives to this position. One student wrote:

> *It would be nice to have lectures, but if this is not possible then the course is structured fairly well. The use of perhaps 3 tutorials/workshops at critical times in the course would be the next best thing!*

What can be seen here, is that once again, the multiple nature of student responses led to more work designed to keep the majority of students happy[3]: Daniel developed a set of video-taped lectures which he made available on-line in the second half of 1998. The preparation of the videos for this purpose was not a trivial task. Lectures were recorded and digitised before the start of teaching (a process which involved still more people and things in the network), and distributed via the Web (and CD-ROM mirror) along with slides and, in some cases, animations designed to assist student comprehension. The work was exacerbated by the fact that Daniel had to master and implement the streaming video software himself in the absence of institutional support.

In addition, a weekly session called a "lecture" was re-instituted but functioned more as a question and answer session for the entire class. In most cases students were reminded to post to a discussion list any questions/problems they had to the lecturer a day or so before the scheduled lecture. If there were no questions there was no lecture. At the end of several years of negotiation, therefore, the students in *Computing Systems* had once again manoeuvred Daniel into a situation where once again he was meeting all their varied requests and engaged in more and more work.

Mailing lists

A further indication of the amount of work associated with constant renegotiation of roles is provided by analysis of the role of discussion lists within this subject. Mailing lists are popular systems in most on-line teaching. They appear to offer a simple and efficient communication medium between lecturer and students and between student and student. Over a five year period Daniel experimented with a variety of mailing lists. They ranged from one list for all students to small lists for groups of students and combinations of both. No one combination has been particularly popular with students and the following comments from student evaluations indicate the range of opinions here.

Group mailing list was excellent.

I feel that combining all the students in one large group would be a much better idea. This is because the problems would then be answered faster by more people.

Our group size was too small so the group size needs to be look at so that they stay at 10 members. The main mail list needs to remain in operation.

Only have access to your own group list, with the lecturer sending on anything else that is relevant.

In addition to the work associated with trialing so many variations of a mailing list, Daniel was also involved in responding to student anxiety about their participation on this list. One student commented that:

Most on the list would be scared to take part.

This anxiety was particularly acute during the 1996 offering of the course when a number of the students were

computing professionals studying to get their formal accreditation. When their presence in the course became known it exacerbated student apprehension about participating on a list:

> *The mailing lists are a good idea. When I found out there were working professionals doing the subject, I was reluctant to ask questions. Silly I know!*

This reminds us of the crucial point that there is a big difference between coming up with an educational innovation and actually getting the students to use it. This is the educational equivalent of trying to get kids to eat their broccoli just because it's good for them. While Daniel could identify—and articulate—why he thought students needed to participate in the mailing lists; he had to work extremely hard to get participation happening.

Ironically, however, in the year when participation on the list was quite high, the kinds of messages being posted were initially so inappropriate that Daniel then had to spend the rest of the term moderating the list, and vetting each and every message before it was posted. Even then the students still saw the list as 'wasting' their time. As one student put it:

> *Main mailing list was hopeless. Initially too much garbage appeared (which was later rectified) which should have appeared in the individual group lists.*

Implications and Further Questions

The point of this analysis is not to say that on-line teaching is bad; or too hard; or doomed to failure. Instead, our goal is to try and move beyond the kind of rhetoric that often obscures consideration of the nitty-gritty of on-line teaching.

There are three particular implications that we wish to draw attention to here:

First, all of the things that Daniel added to his assemblage—mailing lists, CD-Roms, 'lecture' sessions and so on—were intended to make the on-line teaching more durable. That is, he was trying to stabilise his network by responding to the demands of students whilst simultaneously negotiating the restrictions placed on his actions by university contexts and policies. Each addition, however, required more policing—more work—with perhaps the most extreme example being provided by the year that Daniel had to read every single email sent to the discussion list, because of the levels of unacceptable behaviour.

Second, the rhetoric around on-line learning or 'going on-line' tends to represent it as an option that will be unproblematically 'innovative' and universally accepted by all students. The students in this innovation, however, were able to negotiate to a point where they had access to all the traditional forms of course delivery—face-to-face lectures, hard copy print materials, lecturer support—*and* on-line resources, CD roms, streaming videos, animations and so on. While it appears common for administrators and others to assume that putting a course on-line will make it appealing, attractive and 'relevant' for 'contemporary life', the evidence of this project is that there is no guarantee at all that this will be the case. Even in a subject which is *based* upon computers, computer systems and the like, the students were resistant to the idea that they had to use the computer as the focus for their learning.

Finally, we wish to make brief reference to an issue that will be focused on more closely in other discussions of this project. This relates to the articulation between ANT analysis and gender analysis. While ANT routinely draws

attention to the people within a network, it does not always emphasise the fact that these people inhabit gendered bodies. As a result, the nature and the kind of work that is required of a human actor may not be specifically emphasised. This is an issue that will be explored in subsequent publications. At this point, however, it is important for us to acknowledged that a feminist application of ANT does not end with acknowledgment of the amount and nature of the work required of the heterogenous engineer. Instead, attention is also drawn to the gendered nature of this work. Daniel conforms in many ways to the stereotypical image of the competent IT practitioner: he is in his mid-thirties, white, middle-class, well networked, internationally recognised with a strong background in computing technology and a position description which aligns him explicitly with technological work and development. He is therefore positioned in a 'positive' and institutionally legitimated relationship with 'technology' generally and information technology more specifically.

This is not an insignificant point in a university which continues to conform to traditional gender patterns relating to the staff and student ratios within discipline areas.

- ☐ 92% of students in Engineering are male
- ☐ 92% of students in Computer Studies are male
- ☐ 79% of students in Health Science are female
- ☐ 78% of students in Education are female

In this context, Daniel has strong, if largely unacknowledged, ties to the university's gender based networks which legitimate and celebrate the use of technology and on-line learning by particular kinds of academics who inhabit particular kinds of bodies: white, middle class, able bodies.[4] Even so, Daniel was continually forced to adapt his teaching/innovation to respond to/in

response to student demand; and was unable to successfully enrol some key actors—including many with access to or control over the money/resources that would have made the stabilisation of his network much easier—in the network.

The key question here is: if a person with almost as much cultural capital as it is possible to have in relation to computers and on-line learning has had to work this hard to achieve even a temporary stabilisation of a network, how much harder will those without those resources have to work?

Latour argues that "Nothing happens between two elements [in an innovation] that the engineers aren't obliged to relay through their own bodies" (Latour, 1993, p. 23). The point for us is that our bodies will relay a negotiation differently depending upon their sex and the meanings ascribed to their sexed bodies. The human body is always sexed—and coded in sex specific ways—so that it is not sufficient to say that competence with technology is culturally valued. For it is technological competence performed by a male body (a white, able, male body) that has the highest value in dominant university discourses.

This insight is made all the more significant if one bears in the mind the twin facts that the majority of teaching or course development at this particular university is done by level a or level b academics, and that the majority of staff employed at this level are women.

Conclusion

As a concluding point, then, it is important to emphasise that I am not anti-technology, nor against on-line learning, computers or computer mediated course delivery. What I *am* arguing, however, is that any attempt to introduce on-

line learning or web based course delivery needs to move beyond the rhetoric and incautious optimism often associated with technology generally, to a much more pragmatic analysis of the nature and kind of work required to introduce and stabilise any innovation. By highlighting the nature and amount of work associated with the stabilisation of a heterogenous assemblage (and drawing attention, also, to the gendered nature of that work) actor-network theory allows us to make more informed judgements about the extent to which any particular technological innovation is, in fact relevant, economic, efficient and equitable.

Endnotes

1 Chief Investigators for the ARC are Chris Bigum, Leonie Rowan, Michele Knobel and Colin Lankshear.

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3 This is a good place to mention the fact that this particular university places a very high emphasis on student retention which, in turn, places pressure on academics to keep students happy and, by further extension, enrolled (in both the university and ANT sense of the term) in a particular course. For a similar kind of reason the university has recently developed a system wide student evaluation system for all courses and all teaching staff.

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