

Adopting and Adapting Information & Communication Technologies (ICT) in Teaching and Learning within a University

Lina Pelliccione (Macchiusi) & Suzanne Trinidad

Faculty of Education

Curtin University of Technology

Perth, Western Australia

Information and communications technology (ICT) impels change. The rate of ICT adoption is likely to increase over the next few years as growing numbers of Faculty across all disciplines in educational institutions adopt and adapt ICT resources in their instructional activities. ICT places additional demands on academic staff such as necessitating the learning of new skills in developing and maintaining course and assessment materials and spending time differently. The new products of teaching will mean some lecturers will have to make a radical shift in their orientation from a view of transmitting information - to one of directly attending to the process of learning of their students. This paper discusses the results of a study that involved surveying the academic teaching population at an Australian tertiary institution and identifying their use of ICT in their teaching and learning. A group of teaching staff were then monitored over 16 months to identify how their ICT environment evolved. Results indicate that teaching staff: have significantly increased their adoption of ICT in their teaching and learning; are committed to providing a successful learning environment for their students; are reflective about the use of ICT; are very clear about the type of support they need to effectively adopt ICT. The findings have also revealed that there has been an increase in the commitment to ICT initiatives by the University as a whole through the introduction of major structural changes in order to put in place appropriate support structures for the adoption of ICTs. University leaders need to be acutely aware of providing the most effective strategies to

promote such teaching and learning environments by listening to and supporting the needs and concerns of those directly involved in the teaching and learning process.

Introduction

Curtin University of Technology, in its quest to become a 'world class university' and to realign to the needs of the Information Age (Dolence & Norris, 1995) has endeavoured to increase the use of ICT into teaching and learning. This has been implemented through a number of initiatives that have taken the form of: professional development courses, grants and awards and a major IT Review project to examine and review the Information and Telecommunications service delivery at the University.

The rate of ICT adoption in universities is likely to increase over the next few years thus increasing financial and infrastructure needs, such as new equipment, more user training and new kinds of courses. Infrastructure can drive the innovation which in turn creates still more demand for infrastructure and support as growing numbers of Faculty across all disciplines and institutions adopt and adapt information and communication technology resources in their instructional activities (Rogers, 1995). As Ramsden (1998) states "it is not so much the techniques of communication technology and computer-based technology that are critical, but rather the underlying concepts of versatility in time and place of learning, and new ways of thinking about the human aspects of teaching and learning, which these techniques can make more easily reliable" (p17). ICT places new demands on academic staff such as necessitating the learning of new skills in developing and maintaining course and assessment materials and spending time differently. The new products of teaching will mean some lecturers will have to make a radical shift in their orientation from a view of transmitting information to one of directly attending to the process of learning in their students. As Fox (2000) asserts "new technologies will not allow us to easily or more effectively do the same things we used to, rather it will change what we do, our work practices and relations, our jobs and our futures. It will also change what and how students learn" (p241).

Drawing on the work of both Rogers (1995) and Moore (1991) the question can be asked have academic staff crossed the point of critical mass for instructional use of ICT in higher education? Many academic staff are just beginning on their journey to use ICT in their teaching and learning due to an increase emphasis at a global level of the Web and communications technologies such as the Internet and email. There is evidence (DEETYA, 2000) that ICT applications have not penetrated university teaching at more than a superficial level, and that the level of expertise and practice is not yet sufficient to ensure that their wider use is considered viable by academics for developing and delivering courses, consequently, universities risk falling behind peers and competitors (p82). Academic staff are using ICT technologies more for personal tasks but not as extensively in their teaching and learning (Macchuisi & Trinidad, 2000; Trinidad, 2000).

Aims

The focus of the study being reported on in this paper was two fold, the use of information and communication technology in teaching and learning by teaching staff within an Australian tertiary institution, and the mechanisms the University established in order to realign themselves with the information age. At certain stages these two coincide to provide a synergy which offer a valuable insight to the culture and environment of the University. Thus the key research questions that guided this study are as follows:

1. How are Curtin University teaching staff utilising ICT in their teaching and learning?

2. What is the relationship between the ICT behaviour of a University's teaching staff and the strategies used to implement the University's ICT strategic planning initiatives?
3. What is an appropriate model for future implementation of ICT into teaching and learning at an Australian University?

Background/Theoretical Framework

It is well recognised that Australian society has now truly entered into the 'Information Age', an era characterised by the electronic transmission of information. Such technologies have brought to the forefront educational concepts such as 'flexible modes of delivery', 'open learning', 'lifelong learning', 'virtual classrooms' and 'institutions without walls'. Although traditional technologies such as print, radio, and television still exist, newer technologies involving audio and video tapes, computers, computer based learning packages, interactive video and multimedia, audiographic communication systems and video conferencing, have now surfaced in our universities. Over the past decade teaching staff at Australian universities have been using information and communication technology in a number of different ways. Such initiatives include word processing of course outlines and articles for publication, utilising spreadsheets as electronic mark books, communicating with colleagues via email, accessing online information resources and delivering courses via the Internet. A number of successful courses and projects using innovative ICT have been developed by many universities, often through special funding (eg. CAUT, CUTSD).

Innovation uptake

One well known model concerning the diffusion of educational innovations has been based on the work of Rogers (1995). He identifies categories of innovation uptake from high level through to low level - innovators, early adopters, early majority, late majority and laggards. Under this model for significant change to occur, a 'critical mass' of individuals need to have adopted and implemented a given innovation (Green & Gilbert, 1995; Deden, 1998; Rogers, 1995). This 'critical mass' occurs when enough individuals have adopted the innovation so that the innovation's further rate of adoption becomes self sustaining. According to Rogers (1995), the key category is the 'early adopters' cohort as this group can subsequently trigger the movement to a 'critical mass' of adopters. The literature suggests that this can be a slow and in many cases, a painful process (Candiotti & Clarke, 1998).

In addition to these 'critical mass' factors, the pedagogical forces that have driven the push for universities to adopt and incorporate information technologies include:

Information access: The World Wide Web has made it possible for all people to access primary sources of information. Mastery of this tool has become essential in order to gain access to an ever growing body of recent and up to date knowledge available to us electronically.

New communication skills: Employers are expecting graduates to be familiar with email etiquette and associated communication tools.

Asynchronous learning: This initiative has enabled institutions to cater for a variety of students by removing the barriers of time and distance. Students who are normally geographically disadvantaged have access to a variety of resources not usually at their disposal (Deden & Carter, 1996).

With such obvious pedagogical benefits the question must be asked: Why haven't these new and powerful technologies permeated to a greater extent? The literature reveals a variety of

factors that have contributed to the lack of adoption and effective use of ICT at the tertiary level by teaching staff:

Leadership: According to Dolence & Norris (1996), many educational leaders are inexperienced in conceiving growth oriented learning opportunities in the Information Age. They have been forced to deal with constant patterns of reorganisation and restructuring involving the difficult task of redefining values and transforming the culture of their organisation (Middlehurst, 1995; Farmer, 1990).

Other issues appear to have surfaced at the institutional level. For example, Gilbert (1996) points to fragmented institutional planning where institutions fail to match the technology investment with an investment in people (i.e. adequate training, appropriate incentives) (Ehrmann, 1994; Lan, 1997; Williams, 1997; Alexander, 1998). In other institutions, plans tend to be driven by information technology and not necessarily by a pedagogical rationale and focus (Deden & Carter, 1996; Gilbert, 1996; Brown, Burg & Dominick, 1998). The lack of models for integrating ICT into the curriculum (Schofield, 1995; Gilbert, 1996; Northrup, 1997) also contribute to a lack of effective institutional planning.

Technology infrastructure and cost: Lack of uniformity in computer hardware and software systems (Brown, Burg & Dominick, 1998) within the one organisation is another factor noted in the literature as hindering the adoption of ICT. There also appears to be an assumption that technology will reduce operating costs and increase productivity (Green & Gilbert, 1995).

Innovation and change: As with many other kinds of innovations, even when technology has been well established, its greatest potential is rarely achieved (Candiotti & Clarke, 1998; Lan, 1997). It should be noted that one of the major factors contributing to the lack of adoption of any innovation, not just information technology, is the entrenched attitudes of the teaching staff along with an associated reluctance to change (Fullan & Stiegelbauer, 1991; Candiotti & Clarke, 1998).

Resources: One of the major concerns for most institutions is a lack of resources and funding. People resources are stretched to the limit and teaching staff are not only asked to do more, but they are expected to do it differently (Gilbert, 1996; Northrup & Little, 1996).

This paper reports on a longitudinal study that has attempted to identify effective strategies for implementing information and communication technologies into teaching and learning at Curtin University of Technology during the period of 1999-2000.

Research Methods

Data were collected over a period of two years and allowed the researcher to note changes in the behaviour and attitudes of specific individuals and to explore the origins of these changes. Figure 1 graphically depicts the relationship between each of the samples and the corresponding instrument.

Figure 1: Sample Population Used for the Study

A variety of instruments were used throughout the study which when combined, provided a comprehensive picture of the case study sample. To begin with the Curtin University Information Technology survey (CUIT survey) was sent to all full time staff who were actively teaching in Semester One, 1999 at Curtin University of Technology (N=715). This instrument was specifically designed to establish baseline data about teaching staff at Curtin University with regards to the use of ICT in their teaching and learning. To measure change over a period of time the existing practice and related bench marks were identified. The survey was also designed to identify individual and group profiles of ICT attitude, awareness and uptake, and from this information a stratified sample was selected for in-depth case study utilizing the profiles of staff, based on Roger's (1995) classification of innovation uptake.

A semi structured interview schedule was designed to allow the researcher to gain a deeper awareness of the ICT culture of each participant. Fifty participants were selected, however only 37 were able to participate. Each interviewee was then asked to participate in the following phase which involved identifying individual ICT changes which occurred over a 12 month period via an electronic reporting system called the TracIT. The TracIT report used on a monthly basis, provided a guide or proforma to help the case study participants (N=32) focus on certain ICT issues: *Teaching; Students; Training; ICT Support and ICT Facilities*. As time progressed the case study participants ventured outside these boundaries and used the headings simply as a reminder or focal point.

It is important to note that individual profiles (reflecting ICT use, access, attitude and views of ICT in teaching and learning) of the case study participants had previously been established through the survey and the interview data, however, the TracIT reports were used to identify changes that occurred over the subsequent 12 month period.

Findings

Background Information of the Samples

Table 1 presents the staff profile derived from the CUIT survey data for each sample group identified involved in the study.

Table 1: Background Information of the Respondents (CUIT survey)

<i>Background Information</i>		<i>CUIT survey Sample N=384</i>	<i>Interview subsample N=37</i>	<i>Case study sample N=32</i>
<i>Gender</i>	Male	60.4%	70.3%	68.8%
	Females	39.6%	29.7%	31.3%
<i>Age</i>	20 - 29	3.1%	8.1%	6.25%
	30 - 39	25.0%	21.6%	21.9%
	40 - 49	33.9%	35.1%	31.3%
	50 - 59	32.3%	24.3%	28.1%
	60 - over	5.5%	10.8%	12.5%
<i>Years at the University</i>	0 – 5 years	41.7%	48.6%	46.9%
	6 – 10 years	24.7%	24.3%	25.0%
	11 – 15 yeas	15.4%	10.8%	9.4%
	16 - over	18.0%	16.2%	18.8%
<i>Employment Status</i>	Tenured	61.5%	64.9%	65.6%
	Contract	32.2%	32.4%	31.3%
<i>Position</i>	Senior Research Fellow	4.7%	0.0%	0.0%
	Associate Lecturer	7.3%	2.7%	0.0%
	Lecturer	50.8%	62.2%	65.6%

	Senior Lecturer	19.8%	29.7%	28.1%
	Assoc/Prof & Professor	15.1%	5.4%	6.2%
<i>IT Training</i>	None/Self Taught	70.3%		
<i>Mode of Teaching</i>	Lecture and Tutorial (workshop or lab.)	86.7%	91.9%	90.6%
	Tutorial (Workshop or Laboratory)	10.2%	5.4%	6.3%
	Lecture	2.1%	2.7%	3.1%
	External & Distance	0.5%	0.0%	0.0%
	On-line	0.3%	0.0%	0.0%
	<i>Web-based units within the above structures.</i>	<i>4.7%</i>	<i>8.1%</i>	<i>6.3%</i>

One of the key questions in the survey was directly linked to the theoretical framework adopted by Rogers' (1995) in his work about the diffusion of innovations. This question was a crucial one in that it not only provided a picture of the teaching staff's level of integration of ICT into their teaching and learning but the levels were used to select the interview sub-sample and hence the case study sample. The respondents were asked to rate the degree to which they had integrated ICT into their own teaching and learning practices, based on Rogers' (1995) adoption of innovation categories. This self-rating exercise was intended to gauge their integration status compared to their perceptions of the standards of their colleagues within their own School/Department - in other words they were required to rate themselves against their colleagues. The rating required was on a five-point scale, ranging from very low to very high. Other questions in the survey and the interviews attempted to verify this data.

Level of ICT Integration

A synthesis of the data from all of the instruments produced a comprehensive ICT profile for each individual case. This profile, which reflected each individual's working regime and environment for a period of 16 months, was used to compare and relate their level of integration to the level of integration of the others in the case study sample enabling the researcher to assign them a 'University Rating'. Table 2 identifies the level of integration for the various samples according to the survey data and the 'University Rating' assigned to the case study sample by the researcher.

Table 2: Level of ICT Integration into Teaching & Learning Rating

<i>Level of Integration</i>	<i>CUIT Survey Sample</i> <i>N=384</i>	<i>Interview Subsample</i> <i>N=37</i>	<i>Case Study Sample</i> <i>N=32</i>	<i>University Rating</i> <i>Case study sample</i>
Very Low	12.8%	13.5%	15.6%	9.4%
Low	26.6%	21.6%	25.0%	21.9%
Medium	27.9%	18.9%	21.9%	25.0%
High	22.4%	24.3%	15.6%	18.7%
Very High	9.4%	21.6%	21.9%	25.0%

Figure 2 (found on the following page) graphically reflects the individual self rating (survey data) and the university rating for the case study sample. In attempting to identify the impact of ICT at Curtin University it is important to note that individuals within the University have not felt this impact uniformly. Some more profoundly than others – the University is made up of many units each designed for a variety of purposes, forming different structures, adopting different approaches and practices due to individual experiences and attitudes. Rogers' categories enable us to make some generalisations about the rate of adoption.

Identifying Real Change in the Adoption of ICT in Teaching and Learning

In order to obtain an overall picture of the changes in the adoption of ICT and when they occurred over the 12 month period for all of the case study sample, the comments made for each month on the TraCIT Report were summarised and divided into comments which reflected 'real change' in the individual's usual pattern of ICT use and those comments which simply reflected their existing pattern of use. In other words 'real change' was seen as a behaviour which had not been identified either in the survey or the interview data.

Figure 2: Case Study Individual Rating and University Rating

It is important to note that any change identified was of an individual nature, independent of the behaviour patterns of other case study individuals. This meant that a certain behaviour or initiative considered to be a 'real change' for a particular case study individual, may not be compared to others. (e.g. creating an online unit could be considered a 'real change' for someone, yet not for another because their existing teaching and learning practice already involved online units). The changes were allocated to the key focus sections identified in the TracIT reports: *Teaching; Students; Training; ICT Support and ICT Facilities*.

Teaching and Student Changes

The most common changes found amongst the case study sample regarding their teaching and learning practices were involved with: adopting new software, modifying software to suit individual teaching needs, producing Web-based material, and creating CD Roms. For example:

I am busy trying to convert two units for Web delivery using Frontpage. We will be converting or rewriting all of our units for Web-based delivery over the next twelve months. (ID241:Aug99).

An important outcome of a comparison between the CUIT survey data and the actual interview (conducted some three months later) data was that the number of respondents using Web based materials in their teaching and learning had dramatically increased from 8.1% to 32.4%. A further 13 months from the time the interviews were conducted, the TracIT reporting system revealed a further increase in the number of case study respondents who were using Web based material to 59.4%.

Over the 12 month period the majority of the case study sample indicated that they used electronic communication extensively with their students (communication, email lists, WebCT bulletin board, WebCT internal email system, acceptance and marking of assignments).

Through the TracIT reports half of the case study sample identified the changes involving the types of assessment tasks being set for their students – referring students to electronic sources; asking students to analyze data using specific software, complete on-line quizzes, create web pages, and present information using Power Point and data projectors.

In an attempt to adopt more ICT in their teaching and learning, some (28.2%) of the case study participants were reminded of the need to take small steps on their ICT journey not giant leaps. For instance, students required help obtaining specific skills before being able to leap into applying ICT in their own learning. For example:

...had to show them (students) how to use the web, Power Point and Excel...big learning curve and many students complained about computer access at home and printing costs (ID255:March2000).

The real changes that were identified by the case study sample specifically relating to students involved: changes in students behaviour compared to previous groups of students; changes in the tasks that had been assigned to the students which involved more ICT use; changes relating to the problems students were facing because they were expected to work in an electronic environment. For example this comment emphasised the rapid change and expectations of students:-

(students)Are decidedly more computer literate than last year's first year cohort. This means real change for teaching because students expect staff to

be there in a university of technology. The change hurts when you can't put a brake on the speed (ID252:April2000).

ICT Support and ICT Facilities

The changes in the ICT support structure found within the individual Department /School/Division contributed to many of the real changes identified over the 12 month period, while the level of the support also drew much attention and appeared to cause many of the changes. For example these comments show the diversity:

IT support more readily available for specific needs. Lecturers unable to get support last year (ID181:April2000).

Change in IT support (one person left) – work load too high, resulting in an important piece of software not being installed – had to change assessment tasks (ID375:October1999).

There were many comments which surfaced during the TraCIIT report expressing concern about the lack of facilities - these comments were coded as related to an 'existing pattern of environment' as they were describing the individual's current situation and in most cases the situation had not changed. Many of these changes noted regarding facilities referred to hardware and software upgrades and the leasing of new equipment. These comments were made in the light that the recommendations of the IT review and structural changes of IT support were just being felt by the case study sample. For example:-

We have created a new 6 seat computer lab for the first time – Masters entry students (new course). I acquired a Zip drive for large sound files. I have also acquired 'software' to help me with my complex list of things to do and other responsibilities (ID283:January2000).

Over the 12 month period the majority of the case study sample indicated that they used electronic communication extensively with their students – (to communicate, set up email lists, use the WebCT bulletin board, WebCT internal email system, accept assignments and mark assignments). A group of four of the case study participants were yet to encourage email use with their students. This is not to say that it did not occur, as noted by this particular case study person in their interview "*Students are very ingenious and they find my email address*" (ID:Q9). There also appeared to be an increase in the amount of emails for a third of the participants. For example:

Overseas and distance ed students are all using email to talk to me and send assignments. Local students have almost double their email contact with me in the last 12 months, so I seldom have students coming to the office door - even during nominated 'consultation periods (ID245:July/Aug2000).

Summary of Changes

The TraCIIT reports revealed that existing work practices of teaching staff in this University were definitely changing to meet the needs of the University. With this changing face of academic life certain professional attributes came to the forefront. For instance, the ability to be flexible able to work anywhere and anytime. A total of 84.4% of the respondents had email and Internet access at home and identified that they also worked at home. Case study participants were also found to be committed and resourceful - there appeared to be a real

commitment from a large group of the case study sample to improving their ICT skills, through formal training and 'self training'. The majority of the case study sample were reflective about their use of ICT for teaching & learning. Another attribute was collaboration. Many of the case study participants called upon their colleagues for help, with the reverse also occurring, case study participants helping their colleagues.

Along with these positive professional attributes the case study sample were also identified as being over worked and overloaded by information. The references to the heavy work load (teaching, research & committees) and lack of time experienced by the teaching staff was evident throughout all of the instruments used over the 16 month time period (CUIT survey, Interviews, & TracIT). Information overload was certainly felt by the case study sample over the 12 months. There were many examples throughout the TracIT report specifically relating to stress which appeared to be from having to do more tasks with less help and less time and with not so familiar tools. There also appeared to be an increase in pressure from students for teaching staff to adopt ICT in teaching & learning. This was also identified in another Australian study by McNaught, Phillips, Rossiter & Winn, 1999. All of the case study respondents, regardless of their level of integration acknowledged the importance of ICT support, what differed was the degree of support and the type of support they required to effectively adopt or continue utilising ICT.

Discussion and Conclusions

In light of the extensive data derived from this 3 1/2 year study, it is apparent that if higher education institutions are to meet the needs of the Information Age, major transformations need to occur. The key to unlocking the nature of such a process is to re-conceptualise the very roots of higher education institutions. If universities are to survive in the future the evidence is that they need to view themselves as a total professional learning community. The key principles of a professional learning community encompass a number of characteristics which have been derived from the individual work of Alvesson (1993), Senge (1990), Sergiovanni (1993) and Fullan (1998).

Professional Learning Community

The suggested model outlined below in Figure 3, was empirically derived from the data obtained in this study - more specifically from the data collected for the purpose of answering the specific research questions, the numerous issues which have arisen from the emerging themes, and relevant contemporary theory on change and innovation.

Figure 3: Professional Learning Community Model

The results derived from the current study are strongly suggestive that the glue that binds together this type of 'Professional Learning Community' is commitment - strong commitment from the university organisation and strong commitment by individual members. This model proposes certain elements which reflect university and individual commitment and it is only when there is a synergy between these forces that real change can occur and be sustained. Such a community will be better able to meet the demands of the Information Age as well as respond to other changes the future may bring. The following sections expand on the characteristics and implications of the suggested model.

University Commitment

A number of elements involving quality leadership, university policies, professional development and infrastructure espouse a university's commitment to developing a Professional Learning Community.

Quality Leadership - As outlined in a number of previous sections, leadership is one of the most important elements when attempting to develop a Professional Learning Community that will be able to sustain effective technological change. Leaders need to be aware of the human face of change and critically evaluate the need for certain change. Leaders are also responsible for setting goals and striving for certain standards within predefined time frames and one of the keys to being a good leader is making sure that these expectations are realistic and humanly possible. There is strong evidence in this study that Curtin University has high quality leaders distributed across various levels of the University.

University Policies - The study clearly indicated that academic staff face insurmountable challenges if they are expected to produce high quality research, innovative teaching and meaningful community service. This particular issue is also highlighted by Boyer (1990), Fisher (1994) and Baldwin (1998) who each question the value of every academic staff member engaging in teaching, research and service. Institutional policies need to reflect this concept by providing initiatives which encourage and support Department/Schools to allow individual staff to negotiate their teaching, research and community service balance according to their interests, expertise and the specific needs of the School. These duties could be negotiated on employment and continued at annual reviews with the Head of the Department/School. Interestingly, in the case of this University, it allows individuals to make such judgements about the balance of their own teaching and research tasks in the work place in its internal promotional procedure.

The data from the present study and the available research literature (Bates, 2000; McNaught et al, 1999; Ramsden, 1998) have clearly indicated the need for any model to incorporate effective reward structures and incentive schemes which value teaching as much as research. This is especially important if ICT is to be effectively integrated into teaching and learning as the findings have clearly shown that the use of ICT in teaching has actually contributed to an increase in the overall work load of teaching staff.

As a direct result of this study it is suggested that an equivalent process to the operation of the Research Performance Index (RPI) which tracks and rewards research activities, be introduced across the University for teaching. This process also should include dimensions which directly relate to the use of ICT in teaching and learning. As the adoption of ICT becomes part of the overall working culture of the University, the University's remote access facilities and policies relating to these facilities, need to be continually monitored and adjusted in order to reflect the specific working needs of the teaching staff.

Professional Development - The results of the present study clearly suggest that the University should integrate regular professional development within the normal working

environment of all staff. Further, any model or plan for ICT integration for the University should establish strategies and provide resources whereby individuals can analyse their own professional development needs and identify the most effective method of meeting these needs. A comprehensive set of University performance standards in this area would aid such a process as well as the introduction of a monitoring system such as the TraclT reporting system. Initiating such mechanisms would demonstrate that the university valued reflective practice as part of an individual's own professional development. The University also needs to develop its professional development initiatives from a wider variety of sources. A powerful tool in this specific area of professional development is the modeling of effective use of ICT in teaching and learning.

Infrastructure - It has been clearly documented in the literature (Bates, 2000; Green, 1999; Jacobsen, 2000; McNaught et al., 1999) as well as through this study, that for effective use of ICT in teaching and learning, high quality technical support is crucial. More importantly the evidence from this study is that such technical support needs to be sourced within the Department/School and that the people who are providing the service need to adopt a more 'humanistic' approach to those they are helping. The range and varied use of ICT across the university also calls for different levels of ICT support. It is no longer appropriate to have a 'one size fits all' approach.

An important outcome of the study was that the use of Web-based material at Curtin University has dramatically increased over the period of the study. This increase in use has placed more pressure on existing resources. There now appears to be a strong need for technical support to encompass and assist in the mechanics of developing and maintaining Web-based environments. As more staff adopt Web-based environments the need to support students will be magnified.

Universities cannot promote the use of ICT in teaching and learning without providing adequate support and as more people adopt ICT the support needs are simply going to increase. It would seem that a project team model such as the one advocated by Bates (2000) would assist with many of these support issues. The unit could comprise of one technical support person (1:25 staff utilising ICT for teaching) and one generalist educationalist technologist (1:50 academic staff) as strongly suggested by Bates (2000).

If ICT is to be seen as an integral part of the teaching and learning process then the University must provide ample computer access and projection facilities in all teaching classrooms. Remote access facilities for staff need to be provided free of charge and Department/Schools should be encouraged to support leasing laptops for staff instead of stand alone computers. This will enable staff to take advantage of the full flexibility of ICT. Such hardware/software should be upgraded on a regular basis by a technical support team.

The research data clearly indicates the need for universities to be flexible when implementing certain hardware and software policies. Standardising equipment is required for all of the obvious reasons, however there needs to be some flexibility where innovators can continue to experiment at the cutting edge. Weigel (2000) warns universities of the need to be aware of falling into the trap of "commoditisation", where products or services become standardised so much to the extent that their attributes are roughly the same. The following comments reflect the concerns made by one of the case study participants:

I think that IT innovation flourishes best in semi-archaic IT environments where innovators have the opportunities to try out things that are not always compatible with corporate users. Long term implementation is another matter since once these innovations have been tried and found useful, a more robust

system would be appropriate. At the same time the innovators should still be able to experiment etc. (ID218:Oct99).

Individual Commitment

At the individual level teaching staff need to demonstrate their commitment as members of a professional learning community through examining and participating in the following key practices: receptivity to change, attitude toward ICT, reflective practice, life-long learning, collaboration, modelling best practice, principles of andragogy, and finally meeting the needs of the current environment. It is important to note that these were the elements which were generated from the key findings of this study.

Individual teaching staff need to develop a sense of professionalism by questioning their own receptivity to change and personal attitude toward the adoption of ICT. This is vital as nearly half of the CUIT survey sample at Curtin University indicated that they needed to see a proven need for ICT in their own discipline. Another key finding was that 40% of the same sample noted that they felt uncomfortable with the technology itself and that the level of ICT expertise of these individuals ranged from very low to very high. Questioning one's receptivity to change and attitude will only occur through an awareness of the change process and a sensitivity to the needs of the environment.

Engaging in reflective practice is commonly viewed as an important part of the professional development of all teachers and hence a key element of the model. The research data has demonstrated that many of the Curtin University teaching staff involved in this study were reflective about their use of ICT. It is only through use and reflection that teaching staff will truly be able to integrate ICT in an effective manner which encourages deep and meaningful learning.

Time is a precious resource and individual staff need to continue to be resourceful as they have shown in the past, and engage in appropriate professional development activities. Becoming part of a professional learning team is an effective way of creating an ongoing support structure which builds in professional development for life-long learning, such as those witnessed in Curtin University's LEAP project.

The study clearly reveals that individual teaching staff need to be able to manage their time more efficiently and effectively as global factors continue to impact on higher education institutions and in turn on their local working environment. Spender (1998) used the term 'learning managers' which certainly appears to be appropriate for future educators. Teaching staff need to effectively manage their own learning, as well as their student's learning.

It has been documented that a variety of factors have contributed to their increased work load. In particular, the ease of access to ICT facilities (such as word processors, electronic mail), less administration help, information overload, and the introduction of Web-based teaching environments. When adopting new technology into their teaching practices, teaching staff need to employ sound andragogical principles which recognise the interests, needs and developmental readiness of their students - importantly these will differ depending on the group of students at that specific time. As such it is considered important to include this dimension in the proposed model.

Final Comment

This study has attempted to examine the adoption and use of ICT in teaching and learning across a university. From this data an empirical framework or model called the Professional Learning Community Model has been introduced. The data collected in this study indicates that Curtin University of Technology has demonstrated its commitment to the use and encouragement of ICT in teaching and learning through a number of initiatives implemented in recent years. For instance, the establishment of the Office of Teaching & Learning, a parallel division to the Research and Development Division. The variety of professional development courses (Surviving IT, Computer Literacy for Academics, WebCT, Teaching & Learning @ Curtin) established for Curtin University staff is yet another example of the University's commitment. The introduction of the Innovative Teaching Practice Award (ITP) program at Curtin University was initiated by the Office of Teaching & Learning to provide recognition and reward for exemplary teaching by individuals, teams and schools. The Learning Effectiveness Alliance Program (LEAP) is one of the major strategies implemented by Curtin University of Technology in response to the key strategic priority "Introduce reward mechanisms for good teaching" (Curtin University of Technology, 2000).

Curtin University employed an outside contractor to conduct a review of the Information Technology & Telecommunications (IT&T) service delivery (the IT Review) at Curtin University. Further commitment was evident in the policy & planning process Curtin University adopted, as it appears to have adopted a more 'entrepreneurial' approach to Strategic Planning and hence management of the University (Strategic Plan 2000 – 2005).

Many of the teaching staff at Curtin University involved in this particular study have clearly demonstrated their commitment to the adoption of ICT in their teaching and learning. The detailed case study data have also revealed that many of the teaching staff possess professional attributes which would be admired and valued in any university. Through the various instruments the teaching staff were able to identify the factors which hindered the adoption of ICT at an individual level. Factors such as lack of, time, resources, facilities, technical support, software support, a favourable attitude and perceived benefits. Many of these factors are certainly not restricted to Curtin University, in fact as identified in the literature they appear to be universal.

The problem universities face today and in the future will not just be about creating strategies to encourage the adoption of ICT in order to achieve a preconceived 'critical mass' - the challenge will be how to keep up with the demands these changes place on the overall system. How will universities provide the appropriate infrastructure and support for academic staff to continue effectively integrating ICT in their teaching and learning? If this support is not provided teaching staff will simply return to what they know works for them (Fullan, 1992). What we do not want to promote is the following view from a university teaching staff.

*I will not be using the web again - it is too stressful, time consuming, not worth the effort and there is inadequate support at all levels.
(ID:375January2000).*

The study has identified that such commitment needs to come from two levels - the university and the individual - and if this does not occur, the university will be faced with individual staff feeling frustrated and unsupported. If individuals are unable to commit to their role in developing a truly professional learning community then the university may not be able to meet the needs of the current environment - and putting at risk the teaching quality of the whole university. This study has clearly shown that it is only through the synergy of university commitment and individual commitment that real change can actually take place,

the change in this case being the adoption of ICT in teaching and learning practices. The strategies suggested by the participants in this study and formalised by the empirically derived model suggested, are a beginning of the journey to teaching professionalism at the university level.

References

- Alexander, S. (1998). Human touch trumps IT. *The Australian*. 2nd September.
- Alvesson, M. (1993). *Cultural perspectives on organisations*. Cambridge: Cambridge University Press.
- Baldwin, R. (1998). Technology's impact on faculty life and work. In K. Herr Gillespie (Ed), *New Directions for Teaching and Learning: The Impact of Technology on Faculty Development, Life, and Work*. 76, p7-22, Jossey-Bass: San Francisco.
- Bates, A. (2000). *Managing technological change: Strategies for college and University leaders*. San Francisco: Jossey-Bass Publishers.
- Boyer, E. (1990). *Scholarship reconsidered: Priorities of the professoriate*. Princeton: Carnegie Foundation for the Advancement of Teaching.
- Brown, D., Burg, J., & Dominick, J. (1998). A strategic plan for ubiquitous laptop computing. *Communications of the ACM*, 41,(1), 26-32.
- Candiotti, A., & Clarke, N. (1998). Combining universal with faculty development and academic facilities. *Communications of the ACM*, 41,(1), 58-63.
- Curtin University of Technology, (2000) *Overview of the LEAP Project*. [On-line]. Available: <http://otl.curtin.edu.au/leap/overview.html>
- Deden, A. (1998). Computers and systemic change in higher education. *Communications of the ACM*, 41,(1), 58-63.
- Deden, A., & Carter, V. (1996). Using technology to enhance students' skills. In E. A Jones (Ed.), *Preparing competent college graduates: setting new and higher expectations for student learning* (pp 81-92). Jossey-Bass Publishers: San Francisco.
- DETYA (2000). *Learning for the knowledge society: An education and training action plan for the information economy*. Department of Education, Training and Youth Affairs. Canberra: Australian Government Publishing Service.
- Dolence, M., & Norris, D. (1995). *Transforming Higher Education: A Vision for Learning in the 21st Century*. Society for College and University Planning: USA.

Ehrmann, S. (1995). New technology, old trap. *Educom Review*, 30,(5), 41 – 43.

Fisher, S. (1994). *Stress in academic life: The mental assembly line.*: SRHE/Open University Press: Buckingham.

Fox, R. (2000). Online technologies changing universities practices. In A. Herrmann and M. Kulski (Eds.), *Flexible Future in University Teaching. Centre for Educational Advancement*, (pp235 – 243). Curtin University of Technology: WA.

Fullan, M. (1991). *The New Meaning of Educational Change*, 2nd Edition. Teachers College Press: New York.

Fullan, M. (1992). *Successful school improvement. The implementation perspective and beyond*. Toronto: OISE Press.

Fullan, M. (1998, Nov). *Educational change*. Seminar held at the Hyatt Regency, Perth, Western Australian.

Fullan, M., & Stiegelbauer, S. (1991). *The new meaning of educational change*. New York: Teachers College Press.

Gilbert, S. (1996). Making the most of a slow revolution. *Change*, 28,(2), 10-20.

Green, K. (1999). Campus, computing survey: a national study of the use of information technology in higher education. The Campus Computing Project: Encino, California. [On-line]. Available: <http://www.campuscomputing.net>

Green, K., & Gilbert, S. (1995). Great expectation: Content, communications, productivity, and the role of information technology in higher education. *Change*, 27,(2), 8-18.

Jacobsen, D. (2000). Examining technology adoption patterns by faculty in higher education. In *Proceedings of ACE 2000: Learning technologies, teaching and the future of schools*. July 6 - 9, Melbourne, Australia. [On-line]. Available: <http://www.ucalgary.ca/~dmjacobs/acec/index.html>

Lan, J. (1997). *Meeting technology challenges in teacher education: Responses from schools and colleges of education*. (ERIC Document Reproduction Service No. Ed 403 255).

Macchiusi, L. and Trinidad, S. (2000). Implementing IT at an Australian university: Implications for university leaders. In A. Herrmann and M. M. Kulski (Eds), *Flexible Futures in Tertiary Teaching*. Proceedings of the 9th Annual Teaching Learning Forum, 2-4 February 2000. Perth: Curtin University of Technology. <http://cleo.murdoch.edu.au/confs/tf/tf2000/macchiusi.html>

McNaught, C., Phillips, R., Rossiter, D., & Winn, J. (1999). *Developing a framework for a useable and useful inventory of computer facilitated learning and support materials in Australian universities*. Evaluations and

Investigations Program Report. Canberra: Higher Education Division,
Department of Education, Training and Youth Affairs.

Moore, G. (1991). *Crossing the chasm: Marketing and selling technology products to mainstream customers*. New York: Harper Business.

Northrup, P., & Little, W. (1996). Establishing instructional technology benchmarks for teacher preparation programs. *Journal of Teacher Education*, 47,(3), 213-222.

Northrup, P. (1997). *Instructional technology benchmarks for teacher preparation programs and K-12 school districts*. (ERIC Reproduction Service No. Ed 409 858).

Ramsden, P. (1998). *Learning to Lead in Higher Education*. London: Routledge.

Rogers, E. (1995). *Diffusion of Innovations*, 4th Edition. The Free Press: New York.

Schofield, J. (1995). *Computers and classroom culture*. Cambridge, NY: Cambridge University Press.

Senge, P. (1990). *The Fifth Discipline: The art and practice of the learning organisation*. New York: Double Day.

Sergiovanni, T. (1993b). *Organisations or communities? Changing the metaphor changes the theory*. Invited address, American Educational Research Association, Atlanta, Georgia.

Spender, D. (1998). *Classrooms of the 21st Century*. Keynote address at the Educational Computing Association of Western Australian (ECAWA) 98 Conference: 21 years of vision - leading educators into the 21st century, Notre Dame University, Fremantle, 9 - 10th October.

Trinidad, S. (2000, January). Where are we now? Where do we go? Technology education for the 21st Century. In Fisher, D. & Jong-Hsiang, Y. (Eds), *Proceedings for the 2nd International Science, Mathematics and Technology Conference* (p193-200) Taipei, Taiwan: Taiwan National University.

Weigel, V. (2000). E Learning and the Tradeoff Between Richness and Reach in Higher Education. *Change*, 32, (5), 10. [On-line]. Available: http://web5.infotrac.galegroup.com/itw/infomark/618/283/19544966w3/purl=rc1_EIM_0_A66278481&dyn=7!xrn_3_0_A66278481?sw_aep=

Williams, M. (1997). *Piecing telecommunications IT together - NOT!* [On-line]. Available: <http://www.cowan.edu.au/pa/ecawa/resource/pd/confer/Keynote.htm>