Integrating information technology into university teaching: identifying the needs and providing the support

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Introduction
In spite of claims about the impact of technology on university teaching and the apparent indicators of massive change in teaching and learning approaches, the real changes being experienced by students and teachers within our universities are far less than expected. For the majority of university teachers, it seems that there are still many barriers to moving away from a sole reliance on traditional teaching approaches and moving towards integrating various technologies into their teaching. This paper explores such barriers and suggests a combination of needs which must be met before university teachers are likely to give wholehearted support to these much heralded changes. At a time when most universities are grappling with these issues, suggestions within the paper are aimed at those who are making policies, managing resources and implementing strategies to encourage university teachers to integrate technology into their teaching.

Information technology in teaching
University policy makers and senior managers with responsibility for supporting developments in university teaching are under some pressure to invest resources to move their universities towards more technology-based approaches to teaching and learning[1-3]. Questions arise about where these resources should be directed and what strategies should be used to provide support. It is difficult not to be persuaded by attempts to convince us that university teaching is undergoing a technological revolution. Commercial software companies claim new ways of presenting learning materials which are guaranteed to motivate our very technologically literate student clientele. The government has poured resources into supporting the Australian multimedia industry and has claimed its potential to transform the role of universities[4]. Open learning has become a catchcry phrase and is only one example of new ways of teaching and learning which take advantage of technology. Higher education news is rich with claims about the power of information technology to revolutionize teaching and learning within universities[2,3]. The Committee for the Advancement of University Teaching (CAUT) is inundated each year with applications for teaching development grants which are technologically driven[5,6]. In 1993, 63 per cent of funded CAUT applications involved computer-based technologies to a significant extent[7]. The apparent emphasis on technology-related grants in the 1995 round prompted the Chair of CAUT to make what almost appeared to be a disclaimer that these grants merely reflected the proportion of applications received and were in no way indicative of CAUT priorities[6].

Terminology emerges as a difficulty when discussing the use of technology in teaching. The dictionary definition of technology is broad, including the application of mechanical arts and scientific knowledge. In these broad terms, technology applied to teaching can refer to overhead projectors, slide projectors or other simple applications which have been used for many years. This paper is confined to computers and computer-related applications in teaching; hence the term information technology is used. Even within this parameter, there is a tendency to assume that when we are thinking about information technology which can be applied to teaching, we are thinking about one form of technology or one form of teaching. The picture is much more complex than this. The types of technologies which can be used in the classroom include networking capabilities such as electronic mail and the Internet, computer-assisted tutorial materials, computer simulations and interactive multimedia packages, to name a few. The nature of these technological applications is diverse as is the nature of the ways in which they can be incorporated into teaching approaches. Thus, classrooms which employ technology in educational ways may look and feel very different from one another, as they may be based on different technologies and different educational philosophies. Complex technologies may be used in very simple ways and more simple technologies may be used to transform teaching in quite radical and complex ways. Several authors
have attempted typologies which categorize the approaches either in terms of the technology on which they are based or in terms of the type of teaching they are used to support[8,9]. One difficulty is the rapid rate at which technology is advancing and typologies quickly become dated as new technologies and new applications emerge[10].

The link between educational outcomes and information technology is also problematic. Information technology of itself does not have an educational value unless it is put to work in educationally sound ways. Technology can be misused by teachers as can any teaching tool. The introduction of information technology does not guarantee enhanced teaching and learning. Excellent teaching may or may not involve the use of information technology; poor teaching may or may not involve information technology[8]. The aim must be to use information technology in ways which enhance teaching and learning. This means identifying educational problems or areas in which teaching and learning should be enhanced and employing information technology to overcome those problems or supporting teaching and learning in specific ways. Such an approach suggests that moves to use information technology must be driven by educational needs rather than a desire to use the technology for its own sake. The approach also dictates that developments need to be evaluated to ensure that they are achieving the educational outcomes being sought and that any associated disadvantages of using the technological approach do not detract from its overall educational value.

There is some evidence that certain technology-based teaching approaches when employed in certain ways do have beneficial outcomes for students. Students at one Australian university were “positive to an unanticipated degree” about their use of computer-based education, indicating that it gave them flexibility in following up from lectures and revising material[11]. The advantages of using technology to deliver higher education to the workplace have been reported by Hamer[12]. In a more general way, Laurillard[8] analyses the educational strengths and weaknesses of a range of approaches. The advantages and disadvantages of various approaches have also been documented in a number of reports[9,12].

Why then do we not see widespread use of information technology in teaching? The reality of the university classroom for most of our students remains as it has been for many years – a large lecture theatre in which the professor delivers a lecture, possibly aided by overhead transparencies or chalkboard. Van Homrigh and O’Leary[13] have reported that the majority of lecturers at one Australian university continued to use lecture theatres for traditional lecture presentation even though advanced technology was readily available in the design of the lecture theatre and there were increased opportunities available for alternative modes of presentation. In a survey of academic staff at the University of Canberra in Australia, 61 per cent indicated they used electronic mail in their teaching. 38 per cent used the Internet and only 10 per cent used self-authored or commercially available multimedia packages[14]. Spotts and Bowman[15] have reported similar results for a university in the USA where faculty knowledge of computer technology and related use of instructional technology was found to be low.

Spotts and Bowman[15] argue that instances of innovative uses of information technology appear to be the exception rather than the rule, with the incorporation into practice of new ways of reading and learning taking more time than many realize. “Without definitive data to support this contention that technology is becoming widespread in academe, such an assumption appears not to be well grounded in evidence” (p. 58). Thus, headlines and articles which feature innovative uses of information technology in university teaching are merely indicative that there is a very small number of academics at this “cutting edge”, while the majority have been left far behind. In a review of literature, Calading[16] concluded that “the majority of literature surveyed concerned ‘success stories’ and hence may not be a valid indicator of the full extent of educational limitations” (p. 17). When looking at the whole picture of university teaching, few changes appear to have been made over the years.

What are the barriers?

A number of researchers have undertaken a search for why academics do not appear to be integrating new technologies into their teaching. Some surveys of academic staff highlight a perceived lack of various resources, such as time, equipment or funds, as barriers to the adoption of new approaches[17]. Hammond et al.[18], writing about the UK, revealed issues such as lack of time, financial constraints, lack of training and insufficient information on software as the most significant barriers to academic staff using information technology in their teaching. The picture emerging from these and other studies suggests a common thread of lower than expected adoption of new practices because of barriers such as...
insufficient time, inadequate facilities, too few incentives and a lack of support[19,20].

Interviews with a range of academic staff at the University of Canberra provided some more detailed information about these barriers to the integration of information technology in teaching[14]. The interviews were conducted with staff who had received grants within the university for teaching development projects associated with information technology. Invitations for comments were also made to the entire staff and a few individuals, other than those formally contacted, responded to this invitation and provided data. The major themes emerging from these interviews were concerns about:

- the potential to decrease opportunities for interactions between staff and students;
- difficulties with infrastructure such as inadequate equipment or poorly equipped teaching spaces;
- lack of knowledge and skills of staff;
- insufficient technical support staff;
- a lack of time;
- inadequate resources; and
- the risks associated with implementing innovations in teaching, particularly those using technology.

A number of comments identified barriers which related to insufficient support perceived to be provided by the institution. Respondents referred to insufficient provisions in a range of areas such as training, general support while they used new forms of technology, access to equipment of the form required to use new approaches in their teaching, technical support, resources to purchase equipment and a recognition or acknowledgement of the extra effort invested in developing new approaches to teaching.

The time-consuming nature of developing technology-based materials and approaches was noted, as was the scarcity of time available to commit to such tasks. Some comments related to the gap in understanding between the technology experts and those coping with real classroom issues.

The remaining barriers identified related to the perceived attitudes and knowledge of academic staff. A lack of familiarity with the materials available and with the potential of technology to enhance teaching was identified, as was a lack of knowledge of issues related to the design of computer-based materials. Attitudinal barriers which were identified included a lack of confidence among some staff in using the technology and trying new approaches. Some respondents felt that their colleagues were sometimes entrenched in traditional teaching approaches and could not see different ways of teaching and learning. There was a mention by some that staff were not necessarily convinced of the educational value of changing from traditional teaching approaches. Comments also related to the very large step perceived to be necessary in moving towards technology-based approaches. The picture emerging from these interviews is that, while some, though not all, staff may see the potential benefits from integrating technology into their teaching, the means of achieving these benefits are not perceived to be easy. These academics send a clear message that moving into the world of technology appears time-consuming and uncertain, with insufficient incentives and support for them to make this move with confidence.

The difficulty with these interesting, although somewhat predictable, lists of barriers is that they give few clues to the interrelationships among the points listed and the priorities which must be addressed when attempting to minimize the barriers. There is also no evidence that removing the barriers (if that is indeed possible) will result in changing existing practices. Thus, these lists do not necessarily assist strategic planning for change, particularly in a climate of scarce resources where all barriers are unlikely to be addressed simultaneously or dismantled completely. We need other ways of exploring the issue. Rather than identifying perceived barriers to be overcome, a more useful approach is to take a positive stance and look at the needs to be met for teaching practices to change. Such an approach is not necessarily easily achieved because university teachers are not always able to identify their support needs when they are unfamiliar with educational technology and unaware of the educational and technical potential that the technology has to offer them. It is a case of not knowing what they need to know until they are well along the track of experimentation and implementation.

Towards a typology of adoption

Geoghegan[21] has approached the problem by focusing on the needs of university teachers and has suggested that various social and psychological factors underlie the spread of any innovation, with only 10 per cent of users tending to be early adopters of any new idea. In the case of using information technology in teaching, Geoghegan argues, the factors have combined to “build a veritable chasm between the early adopters of instructional technology (the visible 10 per cent) and the much larger, effectively unengaged, mainstream faculty population”[21, p. 30]. The
argument progresses by suggesting that this gap has been caused by efforts to support developments based on needs identified by the early adopters, not the needs of the remaining academics who require the support:

The support systems that most campuses have put into place to foster the deployment of instructional technology were designed by and for the early adopters themselves, under an unstated assumption that all potential adopters need the same kinds of encouragement, facilities, and support, differing from one another by degree, perhaps, but not by kind (p. 31).

Geoghegan characterizes early adopters of information technology in their teaching as:

• favouring revolutionary change;
• visionary;
• strong in their technology focus;
• risk-takers;
• experimenters;
• largely self-sufficient; and,
• “horizontally networked” (used to working across disciplines and across groups).

In contrast, the mainstream majority is characterized as:

• favouring evolutionary change;
• pragmatic or conservative;
• strong in their problem and process focus;
• risk-averse;
• wanting proven applications of compelling value;
• needing support; and,
• “vertically networked” (used to working within the boundaries of their discipline).

This contrast suggests different support needs for each group and also has the implication that early adopters are not necessarily able to define the support needs of the more cautious mainstream majority.

Supporting the needs of the majority

Given that early adopters will try new ideas and be at the cutting edge with minimal support, it is necessary to turn our attention to the more cautious mainstream majority and attempt to meet their support needs if the full potential of information technology to enhance teaching is to be realized. Given the characterization of this group, it is important that strategies take into account the group’s tendency towards evolutionary change, pragmatic considerations, a problem-solving focus, the need for strong evidence of the value of change, the need for significant support and the links that members of this group have within their discipline.

Although early adopters might argue for the investment of more resources in hardware and software, the majority of academics are likely to be overwhelmed by sophisticated and complex technology unless specific educational benefits are established and changes are brought about more slowly. The implication is that support strategies for the mainstream majority should begin with educational issues and the educational benefits of integrating technology in teaching, rather than the technical arguments and excitement which often accompany technology-based approaches and appeal to those who are stronger in their technology focus.

Given that the mainstream majority will be most swayed by evidence that information technology will overcome specific educational problems and will then require ongoing support in order to effect any change, it is important to focus on the larger educational picture, establish an educational need for the information technology-based approach and then support moves to achieve the desired educational outcomes[21]. For practical reasons, it becomes a case of not pressuring all staff to use information technology in their teaching. Instead, we should be aiming towards a scenario in which staff are willing to explore their teaching with a view to making changes to enhance it; that they know and understand ways of changing their teaching away from traditional approaches when there is evidence of the need to do so; that staff understand the potential for information technology to enhance teaching and learning in specific ways; and, that they then feel confident to pursue developments which provide them and their students with the advantages they seek.

An institutional culture which values and rewards innovation in teaching

With educational issues as a starting point, there is a need for a multi-faceted approach. One of these facets includes an institutional culture in which teaching is valued and efforts to improve teaching are rewarded. Ramsden et al.[22] have conducted a comprehensive study of what characterizes such a culture. In such cultures, the responsibility for the quality of teaching is shared between academics and the institution rather than lying merely with the individual. Such shared responsibility means that institutional resources are committed in various ways to support teaching. A university with a culture which values teaching and rewards efforts to enhance teaching will have a strong statement about teaching within its mission. There will be policies and procedures in place which translate this mission from rhetoric
into policies and procedures which have practical outcomes for teachers and students. Senior staff within the university will be seen to support and value teaching as one of the core activities of academic staff. Specific strategies include: teaching development grants; units which provide support for teaching; a programme of professional development directed at university teachers; awards and rewards for excellence and innovation in teaching; promotion opportunities based on teaching achievements; institutional support for academics to gain teaching qualifications; and an environment in which the risks associated with trying new teaching approaches are supported and rewarded rather than ignored or punished[22].

Assistance with critical reflection on teaching
The next facet relates to individual university teachers and the need for these individuals to see teaching as a practice in which reflection, self-monitoring and evaluation occur to develop new ways of improving that practice. The majority of university teachers do not have formal teaching or educational qualifications and therefore base much of their teaching on approaches with which they are familiar[23]. Most are unfamiliar with the educational literature and with educational concepts which allow them to articulate their thoughts about teaching, understand and critique their practice and then explore alternative ways of seeing and practising their teaching[22, 23]. With strong allegiance to their own discipline a characteristic of academics, university teachers see the discipline of education as an unnecessary, additional burden or a discipline not noted for its user-friendliness. In this regard, one very successful development has been the units within many Australian universities which support teaching and learning through workshops and individual consultancies specifically for the academic staff of the university[24].

These educational development units operate from a disciplinary base of higher education and provide resources, workshops and other professional development programmes, individual assistance, teaching evaluation services, policy advice and sometimes formal, accredited courses on teaching and learning in higher education. The resource commitment to such units is in itself a demonstration of the institutional commitment to support for teaching while the units act in practical ways to provide assistance to individuals as well as groups within the university. One role of this form of assistance is to highlight issues and problem areas which need to be addressed, explore the options available and to provide support while alternative practices are implemented. The Australian Higher Education Council[25] highlighted the value of a university teacher receiving feedback on teaching which is “augmented by conversation with someone with expert knowledge on the teaching and learning context” (p. 39).

Raising awareness about the potential for information technology to enhance teaching and learning
It is in this light of exploring educational issues and problems, looking for alternative (and better) ways of acting and trying new ideas, that information technology naturally emerges as an option to be explored. Information technology can be used to enhance teaching in specific ways to overcome specific shortcomings in existing practices and university teachers need to become aware of its potential advantages and disadvantages as they consider their options. Because many university teachers are not familiar with technology-based approaches and materials, one important strategy is to provide demonstrations of working examples and to showcase innovative applications and the teachers who use them. There is no doubt that teachers learn much from discussions with other teachers, particularly those in the same discipline, who share their experiences in using particular approaches for particular purposes. The element of risk is lessened when working examples are available and the element of uncertainty and isolation is reduced by contact with someone who has already been through the implementation process. Given the “vertical networking” of academics, this contact has value when it occurs with others in the same discipline. Alternatively, the “vertical networks” need to be consciously supplemented by setting up special forums to facilitate sharing of ideas across disciplines.

The need for design assistance
Once the potential is recognized for the integration of information technology into teaching to enhance learning outcomes for students, it becomes a matter of realizing that potential through carefully considered instructional design. This need is often overlooked in a rush to solve technical issues and problems – the imperative of designing materials which are educationally effective is forgotten[26]. Educational technologists or instructional designers have a role in designing educationally sound, user-friendly products. They combine a knowledge of education with a knowledge of technological applications and are able to assist the subject matter...
Support for production and implementation

There is little doubt that extensive technical support is required for the production and implementation of teaching materials which use information technology. For those ventured into multimedia production, a multiskilled team of technical support is necessary for the development phase. Further technical support is needed during the implementation and use of the finished package. Access to expertise in programming, authoring tools, copyright provisions and graphics is required. Some institutions have questioned whether they can afford the costs involved in supporting the production of their own courseware and have limited their support to the purchase and delivery of commercially available materials[27]. Even university teachers who purchase commercially available software require educational assistance with its selection and technical support for its installation and delivery to students.

The need for a technologically comfortable work environment

Although there has been an argument to keep educational issues at the forefront in developments related to integrating information technology into teaching, such developments will not occur if they are met by too many technical barriers within the institution. Even university teachers convinced of the educational benefits of technology-based approaches will be resistant to implementing such changes if the environment is hostile. All basic technology needs must be met and sufficient support provided for academics to feel comfortable with using technology in their daily academic work. Academics are unlikely to integrate information into their teaching if they are uncomfortable about using computers in their research, using electronic mail to communicate and accessing the Internet for their information needs. Furthermore, they will not risk changes to tried and true teaching approaches if the alternatives are hampered by additional work, inconvenience, technical hitches and sometimes outright technical failure. There may be a need to provide a minimum standard of equipment for academics. This may mean that general training and support for using technology have to be upgraded so that academics have a feeling of comfort and confidence about their ability to explore and then introduce applications of technology into their teaching.

Conclusions

When planning strategies to encourage university teachers to exploit the potential of information technology to enhance their teaching and the learning outcomes of their students, there is a tendency to begin those plans with technical considerations of software and hardware provision. Although this paper argues that there is a need for a work environment in which there is a degree of technological comfort, it also argues that the more cautious mainstream majority of academics are likely to be persuaded by strategies which keep educational issues at the forefront. This means ensuring an institutional climate in which good teaching is valued and the risks associated with developing new approaches to teaching are supported and rewarded. Within such a climate, university teachers then require support and encouragement to reflect on their own teaching and consider alternatives which enhance that teaching. Once a culture of such questioning is established, there is a need to raise awareness about the strengths and weaknesses of the technology-based options as alternatives to existing practices. This requires individualized assistance as well as a broadening of awareness through the establishment of networks both within and across disciplines. Awareness about the options available is then extended to particular teaching contexts and issues with the help of instructional designers who assist the translation of educational issues into the design of approaches which have educational value. Development and production of materials require extensive technical expertise which must continue into the implementation and delivery phase.

The strategies described above cannot be achieved quickly nor without substantial resources. As MacKnight[27] has stressed, “the level of comfort faculty reach in integrating different information resources into the curriculum is not achieved in a single event but through continuous exposure, encouragement, and support from colleagues, students, and academic support personnel” (p. 35). Disappointment at the rate of change in university teaching might reflect unrealistic expectations that everyone will automatically follow the trend set by early adopters.
Disappointment will continue if support strategies do not distinguish between the needs of the early adopters and the very different needs of the more cautious mainstream majority. There must be recognition that the latter require extensive educational and technical support before they will change their teaching.

References
3. Campus Review, “Have books by-passed their use-by date?”, 4-10 April 1995, p. 11.