

Technology-Enhanced Teaching and Learning: A Strategic Perspective

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1. EXECUTIVE SUMMARY

At the University of Ulster the use of information and communications technologies (ICT) to support teaching and learning has its origins in the early 1970s. Our strategies ensures the availability of a diverse portfolio of tools and technologies to support local and distance learning, classroom teaching, enriched social learning spaces, and individual as well as group learning situations. In the past 2 years €1.2M was invested in end-point technologies and a further €0.8M invested in ICT infrastructure. We operate five video-conference enabled lecture theatres capable of accommodating a combined audience of 1800, five Learning Resource Centres (LRCs) hosting some 800 desktops, over 200 classrooms with fixed digital services, a desktop-based video-conferencing system, and approximately 30 centrally-managed ICT laboratories containing around 1300 desktops. Through innovative small-scale projects we are expanding the range and adoption rates of technologies to support teaching and learning. Our ICT strategy ensures financial investment is fully supported; similarly the Teaching and Learning strategy promotes the incorporation of ICT facilities within course developments and our Human Resources strategy acknowledges the requirement to develop staff skills and to reward innovations in teaching and learning. The Estates strategy recognises spatial requirements; for example our LRCs have been developed over a seven year period. The paper briefly highlights key features in each strategy and the proactive approach of the Information Services department in the pursuit of technological developments.

2. INTRODUCTION

Today, ICT is centre stage as far as teaching and learning in higher education is concerned. Ulster is a modern University with a substantial reputation for the quality of its teaching and learning, as assessed by the Quality Assurance Agency for Higher Education¹. We consider it strategically important to provide contemporary media and ICT technologies to maintain a competitive position in the tertiary education sector and over the past two year period two additional Learning Resource Centre developments have been completed and €1.2M invested in technology refresh projects in classrooms, IT labs and videoconferencing services.

The project referred to comprised five core objectives, namely:

1. Offer a high quality student experience
2. Ensure associated ICT Infrastructure capacity, reliability and resilience
3. Provide increased network bandwidth, with wired and wireless service provision
4. Ensure a capacity to effectively teach large student cohorts
5. Create a capacity for technology to release staff for re-skilling.

A high quality student experience is achieved by providing appropriate technologies and by ensuring academic staff have opportunity to innovate in how they employ it within their courses. ICT infrastructure considerations, whilst beyond the scope of this paper, are addressed by adhering to a policy incorporating hardware lifecycle management, capacity planning and with business continuity considerations an integral part of procurement and topology planning. Network bandwidth is considered within the associated digital network strategy and takes account of new applications and of increasing demands emanating from existing applications. The advent of the concept of learning space has created increasing demands for wireless networking, especially in social spaces, however our policy is to also deploy nodes in high demand teaching areas. For example, our Magee College campus is a wireless network environment. With increasing class sizes, especially as several undergraduate programmes share common first year modules, the need to address factors including student-staff interaction, cross-campus and intra-campus teaching where numbers exceed room capacity and how to best avail of ICT are important operational issues. Here videoconference linked lecture theatres and the adoption of audience response systems are examples of technologies that help address the needs of large student cohorts. Release of staff for re-skilling is a strategic objective of the central ICT department. Over the past 5-6 years, a major drive has been to shift emphasis from a loan-based media technology provision in classrooms to the creation of fixed provision. This shift has been achieved and with a resulting decline in the need for technical staff to move technology between classrooms. Re-skilling enabled us to strengthen the service desk support function by training staff to support IT problems, as media technologies are significantly less likely to create operational demands.

3. STRATEGIC CONSIDERATIONS

Already referred to are four major university-level strategies, namely:

1. Teaching and Learning Strategy
2. Information and ICT Strategy
3. Real Estate Strategy and
4. Human Resources Strategy.

Duderstadt et al [1] has also clearly identified the elements of a necessary infrastructure as including inter-related strands similar to those we refer to.

¹ See <http://www.qaa.ac.uk/reviews/reports/instReports.asp?instID=H-0185>

3.1 TEACHING AND LEARNING STRATEGY

The strategy has a substantial ICT component dedicated to enhancing provision for teaching and learning. It also encompasses many other aspects upon which ICT has a positive influence, for example excellence and good practice in teaching and support for staff development allied to teaching and learning innovations.

3.2 INFORMATION AND ICT STRATEGY

This is a mature strategy, now in its third release. It encompasses the full portfolio of the university's ICT requirements. In this paper the focus is on teaching and learning, where the associated strategic objectives relate to the technological strands outlined in the introduction. Financial planning, based on a 3-year projection, seeks to ensure funding is made available to undertake technology lifecycle refreshes, equip new real estate and to pump-prime a range of small-scale technology innovation projects associated with teaching and learning. The success of the strategy is measured in terms of the extent to which the institution is able to maintain a contemporary portfolio of technologies and by the level of its use.

3.3 REAL ESTATE STRATEGY

As a four campus university, with a substantial real estate portfolio, much of it directly associated with teaching and learning, the requirement to maintain and develop it is of strategic significance. In the past seven years we have transformed two libraries into LRCs, merged a further two into a single LRC unit, and built a purpose-designed LRC. Our Belfast campus has been extensively rebuilt and modified over a period of 3-4 years and in the process we have established a modern technology-rich portfolio of teaching space, including open plan social areas where wireless networking capability is facilitating new opportunities for students. This campus is a major centre for art and design studies, so the particular needs of these disciplines were foremost in space design considerations; spacious, use of natural light, technology-rich and in several cases, multi-purpose. Our largest campus is currently the subject of a consultation exercise associated with a rebuild programme, as its earliest buildings date to the start of the 1970s. This ambitious project will serve to generate new ideas and to facilitate innovations in terms of how learning spaces will be created. Oblinger [2] in her recent publication describes "spaces as change agents", which we consider to be a truism.

3.4 HUMAN RESOURCE STRATEGY

Our commitment to quality experiences for students is evident in career opportunities and in our staff recognition scheme. For example, academic staff can be appointed to a professorial position based on their contributions to teaching and learning. Furthermore, staff have opportunity to be recognised via our Distinguished Learning Support Fellowship scheme. The lead author holds one of the first awards made under the scheme and work described later was undertaken by a second award holder. These opportunities demonstrate a strong commitment to staff recognition and reinforce the importance of contributions to teaching and learning.

4. TECHNOLOGY EXPERIENCES

A number of examples of technology use are given to highlight user experiences; these examples are associated with strands four and five of the project already referred to. The technologies were piloted, on a small-scale basis, with staff and their students from across a range of disciplines, Technologies selected are:

- tablet laptops in teaching scenarios
- Camtasia
- Audience response system.

Our emphasis is on “hard technology” examples, whereas an interesting and recent study encompassing “soft technology”, in humanities teaching is given by Harley [3].

4.1 TABLET LAPTOPS

These devices, viewed as a successor to the interactive white board, enable users to ‘write’ on the screen, hence facilitating the annotation of text or graphics displayed by an application. Furthermore, a lecturer can prepare notes, diagrams or content within an application in advance of their class and bring it to the classroom. Also work undertaken on the tablet device during class can be saved and subsequently distributed electronically to students.

In the Education department tablet devices were used with student-teachers to facilitate the preparation of interactive teaching modules for use on placements. The portability for both lecturer and student is a major benefit, and the ability to avail of this portability in a school setting, where the placement occurs, is advantageous. One lecturer stated, *“I was able to enhance the interactive aspect of PowerPoint with Windows Journal allowing the groups of students to write their comments on a series of question pages on Windows Journal... Some teacher colleagues who saw the tablet in action wanted to know how to get hold of one! Some were able to make comparison with interactive white boards they use in their schools saying they preferred the forward facing presentation that the table provided.”*

In Business and Management, the device enabled staff respond to students’ enquiries about spreadsheet models by, for example, expanding equations and showing underlying mathematical constructions without having to use another display medium. The device was connected to the classroom projection system, hence allowing the lecturer to write over their Microsoft Excel display and capture the annotations as images for distribution as digital course notes. In accountancy, interactive teaching on professionally accredited courses availed of this presentation style. The tablet device provided opportunity to display and discuss typical industrial strength financial templates, explaining the underlying calculations. One academic stated, *“The tablet has helped me organise my teaching time more effectively... I teach 8 classes a week and I use the tablet for 6 of the 8 classes. My main use of the tablet is working through answers to accounting questions. I also use it to a lesser extent to show slides. I feel I’m better organised than before and can use time in class more efficiently. I wish I’d had the tablet throughout my teaching career.”*

In another similar pilot the technology was used on undergraduate economics courses, again, primarily to explain and explore mathematical models. A further application, in the same faculty, used the tablet laptops for advertising and finance related activities. With access to a digital wireless network academic staff have received assignments directly to their tablet device, undertaken marking and annotated the work before returning it to the student. This flexibility afforded by the wireless technology and a highly portable device, with a digital writing capability, allowed the lecturer freedom of physical location on campus, which was an important feature since many assignments are real-life projects for commercial retailers, where tight deadlines on turnaround times are rigidly enforced.

Staff in Life and Health Sciences supported teaching of radiography by displaying X-ray images via the device used in conjunction with a digital projector. X-ray characteristics of significance were highlighted using the digital pen. This activity is equivalent to the previous example except that imagery replaces text, numbers and formulae.

One student felt the technology was a *“more modern approach rather than 1950s chalk, allowing the lecturer to easily display explanations, plus he could save these and put them on WebCT.”* In the case of Business and Management, plans exist to refit a small lecture theatre as an ‘executive’ teaching facility, providing staff with access to tablet devices and a range of fixed teaching technologies.

4.2 CAMTASIA

In screen casting applications the interactions with software are captured in a multimedia file which can be reviewed at a later date. The captured activity may be enhanced with audio and video overlays and made available for downloading as an independent learning resource.

Library staff used the software to produce online materials for both distance learners and for creating content for inductions. An example relates to a short presentation on the online catalogue, followed by an overview of the steps required to find and reserve a book online, or print an article from an online journal. The finished resource was then narrated by a member of staff. An overview of this project has been presented at the 2008 IUIS Conference, and further licences have been purchased for staff on all the main Campuses, to enable production of further support and induction materials. Camtasia has also been used to present Health and Safety related training in Biomedical Sciences without having to expose students to potentially dangerous scenarios. One lecturer, the recipient of a Team Award Distinguished Teaching Fellowship, stated that Camtasia was "*very easy to use particularly in conjunction with PowerPoint...No major problems were encountered. I intend using it more next year. Overall, I am very impressed with it.*"

In the School of Built Environment several staff now use screencasts to teach AutoCAD, by hosting their content within the university's virtual learning environment (VLE). The success of the pilot is summarised by an academic who advised how the use of Camtasia has, "*benefited both myself and the students. The students were able to work at their own pace, able to repeatedly review the tutorials outside class where necessary and benefited from seeing the action on their screen, and not on a screen at the front of the class. From my perspective, the six tutorials were given fortnightly over a 12 week semester, with each tutorial presented four times! Camtasia standardised the presentation so that no one group of students were advantaged over another, the tedium of giving the tutorial for the fourth time was removed (hence again not disadvantaging a group of students with a poor lecture).*"

The faculty of Business and Management used Camtasia to create narrations in lieu of a traditional lecture and one School is evaluating whether to reduce their number of lectures and replace some with regular podcasts that focus on main topics.

Staff feedback has been mixed; for example the requirement of significant preparatory work to capture and edit is a major startup overhead. Our Institute of Lifelong Learning purchased Wimba Voice Tools to facilitate audio podcasting from within WebCT, so this is an internal rival technology.

Examples illustrating the use of technologies within our newest Learning Resource Centre, opened in October 2007, follow. Group study rooms are popular and useful, especially for the increasing number of students who are required to undertake assessed group activity. These areas are equipped with technology known as Tek Panels², an all-in-one computer with integrated flat screen display. It is perfect for use in area involving multi-taskers, conference presentations or video teleconferencing. Figure 1 shows a typical view of a group study area.

In another case the group study facility was used for awareness training on new databases for a small group of academics. The Tek Panel was used in conjunction with conferencing technology to permit an expert, in London, to introduce the products without the need for his physical presence. In the general area where desktops are provided, the designs of the tables facilitate group work as well as individuals. The integral IT suite is popular with those who arrange subject classes, where students are introduced to electronic resources in support of their discipline. Use of the facility encourages students to focus on the full range of resources available as they are in close proximity to books and journals as well as non-book media.

² See <http://www.tekpanel.com/> for technical specifications



Figure 1: View of Group Study Area, with Tek Panel display

4.3 AUDIENCE RESPONSE SYSTEM

Audience Response Systems facilitate interactivity between the lecturer and students using handheld transmitters. Their use in education is not new, however at Ulster we are piloting the application with large student groups as a means of enhancing student engagement. Martyn's [4] research with 'clickers', whilst not revealing statistically different results between groups who used and groups who did not use the technology, nevertheless does suggest that learning outcomes may be enhanced through use of the technology. With a well designed lecture session, students can actively participate by using the devices to anonymously answer questions and to offer opinions on topics that they may otherwise refrain from engaging with. Typically, controversial and 'delicate' political issues are good examples where an anonymous lecturer-student interaction may be appropriate. Our pilot activity has spanned a range of courses including economics, politics and social policy.

In the case of Policy Studies, a lecturer who received the university's Distinguished Teaching Fellowship Award for her "*consistent enthusiasm for developing new approaches to teaching and learning within the School and Faculty*" used the tool to encourage group interactivity and debate amongst first-years. Early research indicates the system has improved attentiveness in class, helped engage passive listeners, enhanced knowledge retention, and confirmed student understanding of key points almost immediately. Comments from her students praise the technology; one student noted how, "*Everyone was like a 'whole', rather than just in a class where one person sometimes gives all the answers. It helped everyone to be part of the class*". Others said their group "*could give an answer without the embarrassment of being wrong or right and it give us feedback on where we stood with regards to the subject.*"

In another case the technology was used with students studying criminology; here students responded to politically sensitive questions without their peers being aware of their response.

Use of the technology to provide formative feedback using multiple-choice questions with a group of first-year students is another application, this time in the faculty of Business and Management. Weekly, an interactive multiple-choice quiz reflecting the main topics already taught was performed using this facility. Furthermore, in the final week of the module, an end-of-term examination, worth 40% of the module assessment, was conducted with TurningPoint. The test results were distributed, via WebCT, within five minutes of its completion. The success of this application has lead to planned increased use in the incoming academic year.

The software is installed on the classroom PC image to enable its use in any digital classroom.

One-off uses of the technology have been frequent and highly praised by participants. It was used as part of our annual E-Learning conference, and in a conference hosted on behalf of the European Economic and Social Committee. TurningPoint has also been used for end-of-term course reviews and there is interest in its use for attendance monitoring. Overall, the technology has been highly praised, with little, if any criticism. Several departments intend to purchasing their own kits for the incoming academic year.

5. STUDENTS' PERSPECTIVES ON LEARNING AND TEACHING

The majority of students participating in the study recognized that the web-based instructional format encouraged an approach to learning that contrasted sharply with what took place in lecture-based courses. Students spoke about how the course design led them to reflect more and think about their understanding of the course concepts. For some students this reflection included meta-cognitive musings about the teaching and learning processes taking place.

It has been noted that university education, to a large extent, retains a traditional tutor-directed teaching paradigm when present times demand a restructuring that embraces a student-centered learning perspective. The latter perspective is considered more appropriate and pertinent [5]. This requires a shift in pedagogical practices where learning technologies (rather than curriculum) are developed, and quality of learning (rather than instruction) is continuously evaluated (rather than just at the end of the course). The emphasis is to move from an "instruction paradigm" to a "learning paradigm", where the course's goal is to create powerful collaborative learning environments where learning is holistic and interactive, facilitating student construction of knowledge. In future it will be important to critically examine how technology promotes meaningful learning. Technology mediated settings prompt students to reflect on their approach to learning and highlight the importance of the levels of interaction in the teaching and learning process. A carefully designed technology-enhanced environment incorporating either fully online or blended programmes has potential to assist students think differently about teaching and learning. In these environments, students contribute seamlessly to their course and knowledge development process.

6. THE NEED FOR STRATEGIC APPROACH

Technology has the potential to connect the learner to information and learning communities; expand students' participation in the teaching and learning process; improve their access to learning materials, experts, and peers; and provide new channels for active learning. The growing competition and increasing demands of the global market place spells a major need for higher education to confront and deliver enhanced academic programs through developing and using new teaching and learning strategies. Recent reports suggest that competitiveness in the global market has resulted in an increase in higher education and business alliances [6].

Now the traditional teacher-centered pedagogy and curricula no longer meet current and future student expectations. More courses are making greater use of technology as an instructional resource. Today's students are classified as digital natives who seek to completed course using multiple technologies including video conferencing, personal computers and on-line learning tools in high schools equipped with extensive technology infrastructures and with technology embedded throughout their curriculum [7]. Recent studies reveal a dangerous mismatch between what today's student need from higher education and what they receive [8]. It is an expectation on the part of these students, for ICT to be an integral part of the curriculum. The drive for such integration must be based upon a strong commitment to mutual decision-making, investment, risk, and reward. Today higher education has reached a point where advantage must be taken of the geographic reach and functional capabilities of modern technologies including the internet, multimedia, and electronic courseware applications.

7. CONCLUSION

Technology has changed how we live, work, educate and relate to others. It has created a networked world and a global community, resulting in people needing lifelong skills to engage with society. Institutional, national, and global competitiveness ultimately depends on people. Individuals become more competitive when they have the right set of skills; the challenge is how to incorporate these 21st century skills into the fabric of educational institutions. A strategic approach to development and implementation of technology-enhanced teaching and learning programmes is sought. Student-centered pedagogical methodologies, electronic learning, and internet based courses using various modes of academic courseware, student mobile computing, and technology enhancement initiatives are essential elements. This approach should ensure tertiary institutions meet the needs of today's students, whilst determining the critical elements for a teaching and learning strategy, which in itself includes planning, transformation, and the appropriate use of technology to create a more productive mission promoting flexible and independent learning. Milne [9] refers to the "interaction age" and to a fundamental principle of "deploying learning technologies that encourage and support interaction". This principle succinctly states what Ulster seeks to achieve.

8. REFERENCES

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