

Digital or didactic: Using learning technology to confront the challenge of large cohort teaching

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Abstract

This paper investigates whether the selective use of technology can begin to overcome the challenge of large cohort teaching and deliver an enhanced student learning experience. It describes the initial development and evaluation of a campus-based management course taught to 270 third year engineering undergraduates at The University of Manchester. The course is structured around weekly keynote lectures, supplemented with extensive use of a virtual learning environment (VLE) and key Web 2.0 applications.

The preliminary findings are that technology is not a panacea: face-to-face contact with teaching staff remains the priority for most students. Nevertheless, the VLE was found to improve the student learning experience provided that

- Use of technology does not reduce face-to-face teaching time;
- Teaching faculty acknowledges that students are, for the most part, highly strategic learners, engaging deeper with those technology tools that help them achieve their desired course outcomes;
- Close attention is paid to learning design, aligning technology tools with the desired learning outcomes.

Further work is now required to explore more effectively the use of the VLE and Web 2.0 as a vehicle for promoting collaborative learning. In addition, the authors will be re-designing course activities, both assessed and unassessed, to start to address the more lofty ambition of moving students from an acquisitive to a participative model of learning.

Introduction

The number of students entering full-time higher education in the United Kingdom has increased rapidly over the last 20 years. In many institutions this has resulted in larger class sizes, with numbers of students undertaking core modules often exceeding 250 students. The challenge facing higher education, driven by financial pressures to accept increasing student numbers, is how to evolve the student learning experience to meet the expectations of today's students. Didactic teaching in ever-larger lecture theatres may not constitute the optimal approach. Recognising this many institutions have seized on new technologies in teaching and learning as a potential solution to this problem.

Practitioner Notes

What is already known about this topic

- There is an ongoing debate about the effectiveness of learning technology in enhancing the student learning experience.
- There are a number of published case studies describing and evaluating the effectiveness of VLEs in enhancing student learning across a range of disciplines, the majority of which involve small- to medium-sized cohorts.
- Learning technology can be used to achieve more constructivist pedagogical principles.

What this paper adds

- A well-conducted case study of the use of learning technology to enhance large cohort teaching.
- A critical review of the literature on the use of learning technology to enhance student learning.
- An empirical contribution to the debate on whether learning technology can enhance the student learning experience.

Implications for practice and/or policy

- Technology is not a panacea to enable higher education institutions to do more with less.
- Technology can enhance the student learning experience provided that it does not reduce face-to-face teaching time.
- In utilising learning technology, close attention should be paid to learning design, aligning technology tools with the desired learning outcomes.

This view of technology as a panacea has gathered increasing momentum with the publication of a number of seminal texts (Palfrey & Gasser, 2008; Prensky, 2001; Tapscott & Williams, 2008), describing today's students as radically different to previous generations both in their exposure to and expertise with technology and their resultant learning preferences and educational requirements. These students, known interchangeably as Net Generation (Tapscott, 1998; Tapscott & Williams, 2008), Digital Natives (Prensky, 2001), Millenials (Howe & Strauss, 2000; Oblinger & Oblinger, 2005) and Homo Zappiens (Veen & Vrakking, 2006), have grown up with technology (computers, the Internet and mobile devices) as a way of life—utilising online collaboration sites such as Facebook to communicate, collaborate and generally run their lives. Surveys in the United Kingdom suggest that 90% of UK students are regular users of social networking sites on entry to higher education (Melville, Allan, Crampton & Fothergill, 2009). It is argued that as undergraduate students, this Net Generation demands continual feedback, increased interaction with teaching faculty and extensive collaboration in learning (Mason & Rennie, 2008; Oblinger & Oblinger, 2005).

This definition of today's students as a homogeneous, technology embracing, continuously connected group has more recently been critiqued as lacking theoretical underpinning and empirical evidence (Bennett, Maton & Kervin, 2008; Jones, Ramanau, Cross & Healing, 2010; Kennedy *et al.*, 2007; Selwyn, 2008). In parallel, evidence has begun to emerge that students are less prodigious users of technology than may have previously been assumed (Jones C. *et al.*, 2010; Kennedy *et al.*, 2007). These studies have also revealed a more complex picture of today's students; a large proportion of students do make extensive use of many of the available technologies,

but a minority remain unengaged (Bennett *et al.*, 2008). Kennedy *et al.* (2007) offer this stark warning against the adoption of technology as a panacea for all the current ills of higher education.

... be cautious about accepting the claims of commentators who suggest that new technologies and tools in Higher Education will offer an all-purpose solution to eliminate disengagement or dissatisfaction among this generation of students ... (Kennedy *et al.*, 2007, pp. 523–552).

Against this backdrop, this paper describes the implementation of a virtual learning environment (VLE) and key Web 2.0 applications within an engineering management class of 270 and evaluates the extent to which the use of this technology can enhance the student learning experience. The paper does not attempt to measure any improvement in the effectiveness of student learning via measuring student grades. There were two sources of data for the case study: a paper-based survey of the 2009 cohort and analysis of Blackboard usage statistics.

Literature review

The effectiveness of learning technology in enhancing the student learning experience

Proponents of the view that technology can be used to enhance teaching and learning argue that using technology appropriately can both enrich the student learning experience and improve the effectiveness of student learning (Collis & Moonen, 2001; Davidson & Orsini-Jones, 2002; Laurillard, 2002; Mason and Rennie, 2008; Matulich, Papp & Haytko, 2008; Sharpe, Benfield, Roberts & Francis, 2006). Collis and Moonen assert that learning technology allows students to make the transition from a learning process centred on knowledge acquisition to one founded on participation (Collis & Moonen, 2001). Mason and Rennie (2008) support this view by arguing that effective learning is not just a matter of a lonely learner internalising knowledge but of participation in a community of learning. Laurillard makes the connection between use of technology and learning experience more explicit, still stating that

... technology is an engaging and highly responsive medium; it can gather content according to interest; it can respond to individual needs of pace and level; it fits with the style and forms of youth culture; it can link the classroom to the workplace and in doing so allows teachers to provide much more of what only they can do for their students (Laurillard, 2007).

Detractors of learning technology counter that it makes no significant difference (Russell, 2001) and that technology does little to improve learning (Kvaivk & Caruso, 2005). Others claim that the use of new technology can lead to a strategic learning approach, where learners direct their learning to achieve specific course outcomes (Saunders & Klemming, 2003). The Joint Information Systems Committee Student Expectations Study of 2007 reported that face-to-face contact with teaching faculty was still valued most highly by students and that learning technology was viewed only as an adjunct to effective face-to-face teaching (Ipsos, 2007).

This debate has given rise to a proliferation of research into the use of learning technology as a tool for learning in higher education institutions. Much of this research has been empirical, with case studies published on the effectiveness of VLEs in enhancing student learning across a range of disciplines, including Accounting (Broad, Matthews & McDonald, 2004; History (Rogers, 2004), Operations Management (Greasley, Bennett & Greasley, 2004), Engineering (Nortcliffe & Middleton, 2008), Foundation year studies (Turney, Robinson, Lee & Soutar, 2009) and Nursing (Moule, Ward & Lockyer, 2010). These studies range from initial experiments with early versions of VLEs (Greasley *et al.*, 2004) to the specific use of a single aspect of learning technology such as audio feedback to engineering students (Nortcliffe & Middleton, 2008). The findings of these studies lend weight to the notion that the student learning experience, but not necessarily the student's grade, is enhanced by the appropriate use of learning technology. A consensus also seems to be emerging that technology can be used to achieve more constructivist pedagogical principles (Mayes, 2001; Rogers, 2004).

The context of all the earlier studies is, however, small cohorts, ranging from 20 to 70 students. There are few peer reviewed studies of the use of a VLE to enhance the student learning experience within larger cohorts (above 200 students). Patalong (2003) and Vigentini (2009), respectively, report on the use of VLEs to enhance an information skills course (cohort size: 700) and a first year undergraduate psychology class (cohort size: 288). Wood and Henderson (2010) describe the implementation of asynchronous discussion boards in a 200 strong psychology class. These three studies exemplify the challenges facing teachers of larger cohorts and the role that pragmatism inevitably plays when designing effective methods of teaching and assessment for large cohorts (Patalong, 2003).

Face-to-face teaching of these large cohorts of students has always been a challenge. Large classes contain a diversity of learners with varied learning needs and preferences (Vigentini, 2009). In the authors' experience, it is very difficult to engage effectively with students in a one to many relationships in vast lecture theatres. Most students are unwilling to ask questions to test their understanding and feedback is very impersonal, if given at all. In addition, any minor problems concerning the delivery of material or the assessment process are exacerbated by the large cohort size (Wood & Henderson, 2010).

In direct response to these challenges, this paper describes the implementation of a VLE and key Web 2.0 applications within an engineering management class of 270 and evaluates the extent to which the use of this technology can enhance the student learning experience.

Method

The University of Manchester case study

The basis of this study is a third year management course called Operations Management. It is delivered on campus to a single cohort of 270 Civil, Mechanical and Aerospace Engineers. The course spans one 15-week semester and comprises weekly 2-hour keynote lectures. The course is assessed via a group-based project (50% of the final grade) and an end of semester exam (part written and part Multiple choice questions) is also worth 50% of the final grade. The course aim is to challenge the students to think outside their engineering discipline about how companies operate, how they produce their products and services and how they stay ahead of the competition. In previous years student feedback on the course had been mixed with lack of academic challenge, large class size and poor feedback cited as the most problematic issues. In response, in 2009, the authors (also the course lecturers) incrementally changed the existing course, supplementing the keynote lectures with the VLE, Blackboard Vista and selected Web 2.0 tools such as podcasting and Facebook to address these concerns and attempt to enhance the student learning experience. The structure of the course on the VLE is shown in Figure 1.

The key features of the course VLE are described later.

Course materials

Here students can access and download all course materials including lecture notes and PowerPoint presentations. Students can also complete weekly non-assessed multiple choice quizzes on the material covered in the previous week's keynote lecture and access case studies from a variety of companies. There are also links to directed reading from the course textbook.

Your assessment

The VLE was used to organise the coursework. Students were required to sign up on Blackboard in self-selected groups of three and then to complete a group poster analysis of an operations management problem. This allowed the students to collaborate both virtually and physically and to draw on a range of online resources to produce the required poster. All 90 posters were displayed on the course Facebook group (Figure 2). Here students could view each others work,

The screenshot displays the Blackboard Vista interface for a course unit. The top navigation bar is purple with the Manchester 1824 logo on the left and links for 'My elearning homepage', 'Accessibility', 'Help', and 'Log out' on the right. Below this, a secondary bar shows 'Build', 'Teach', and 'Student View' tabs, followed by the course title 'MACE30462 Operations Management (003694) - MACE30462 & LEC1 2008-2009'. The left sidebar is divided into 'Course Tools' (with links like Course Content, Announcements, Assessments, etc.) and 'Instructor Tools' (with links like Manage Course, Assessment Manager, etc.). The main content area, titled 'Course Home Page', features a blue header with the School of Mechanical, Aerospace and Civil Engineering logo. Below this, a paragraph of text describes the course unit. A central section contains six links with icons: 'UNIT INFORMATION' (book icon), 'Course Materials' (folder icon), 'YOUR ASSESSMENT' (clipboard icon), 'YOUR SUPPORT' (person icon), 'Staff Room' (mug icon), and 'Man 3 Podcasts' (antenna icon). Each link has a brief description of its content. The bottom of the page shows a status bar with 'Internet | Protected Mode: On' and a 100% zoom level.

Figure 1: Screenshot of Course Unit Home Page in Blackboard Vista

provide feedback and invite friends and family to view their finished work. These posters also provide a rich source of case-study material, and they will be available to future cohorts as exemplars of operations management in an engineering context.

Communication and feedback via podcast and discussion board

The course lecturers recorded weekly 5-minute podcasts to provide direct feedback to the cohort on their performance in weekly multiple choice quizzes. These multiple choice quizzes were designed to test the students' understanding of the lecture material and help embed the concepts introduced in the lectures. The quizzes were automatically marked by the VLE, enabling the lecturers to see which questions had caused the cohort difficulty. This allowed targeted rapid audio feedback to be provided to students. The podcasts were simple to record using the standard podcasting tool provided by Blackboard, and there were no technical glitches throughout the semester. An asynchronous discussion board was also provided within the VLE, where students were asked to post general questions about coursework or lecture material, enabling answers to be available to the whole cohort. Interaction with both podcasts and the discussion boards was optional and not assessed.

There were two sources of data for the case study: a paper-based survey of the 2009 student cohort and analysis of Blackboard usage statistics. It is recognised that these data sources only provide the "what, when and how" of the students usage of and preference for learning technology. Impending end of semester exams frustrated the authors' attempts to hold focus groups and thus probe more effectively the "why" of technology use and preference. However, the open comments section of the survey mitigated this in part by allowing responders free reign to express their views.



Figure 2: Screenshot of Facebook poster presentation site

Other acknowledged limitations in the study are, firstly, in the definition of “enhanced student learning experience.” The authors of this study have deliberately not defined what is meant by enhanced student learning experience, as each student will have a different view of what this statement means to them. It is the very fact that the individual student believes that their learning experience has been enhanced through the use of the VLE that is being measured by this study, irrespective of whether their understanding of enhanced learning experience relates to more personalised learning, deeper learning or that they have simply found the VLE to prepare them more effectively for the exam.

A second limitation is that the respondents to this survey were those students that attended the revision lecture. It is possible that this introduced a bias into the sample in that students attending the revision lecture were not representative of the whole cohort. However, many more students attend the revision class than attend a typical weekly lecture and so this method was retained as a means of ensuring a satisfactory response rate. In spite of this limitation, the size of the sample and the fact that it is representative of the whole cohort in all other ways should allow the results of the study to provide a meaningful benchmark in measuring the impact of the VLE on the student learning experience in large cohort teaching.

The questionnaire was designed to be short with a completion time of under 10 minutes and was piloted on a group of six students. Anonymity of students was assured, as a means of minimising potential ethical issues of the researchers also being the assessors. The questionnaire asked how often students had accessed eight different learning tools on the course (including the keynote lectures and the Web 2.0 tools). Students were also asked to rank the learning tools in order of effectiveness. The students were then asked whether the use of the VLE and the additional Web 2.0 tools had enhanced the student learning experience, and whether their use should be extended to all other course units. Responses to these two questions were graded using

a 5-point Likert scale (*strongly agree* to *strongly disagree*). At the end of the questionnaire there was an open question asking students to make further comments on the use of the VLE in the course.

Results

Students completed 146 questionnaires (response rate of 56%). Respondents were 84% male and 16% female, with 95% of respondents under the age of 25. These figures are in line with the cohort gender and age profile. Interestingly only 66% of questionnaire respondents described themselves as regular users of social networking and other Web 2.0 tools in everyday life—this figure is lower than the nine out of 10 of UK students quoted by Melville *et al* (2009) as being familiar with social networking sites on arrival at university. The lower figure obtained by the questionnaire survey seems to corroborate earlier research by Kennedy *et al* (2007) and Jones C. *et al* (2010) that students are less well acquainted with Web 2.0 tools such as blogs, social networking and podcasting than one might assume.

The questionnaire survey results were enlightening, with clear distinctions emerging between the course features that the students found to be effective tools for learning and those that were not. Figure 3 shows the most accessed tools on the course unit and Table 1 shows the respondents' ranking of the effectiveness of these tools in enhancing student learning.

The most accessed learning tool remained weekly attendance at the keynote lectures, with over 90% of respondents attending some or all of the time. In addition 54% of respondents ranked the weekly keynote lectures as being the most effective tool for learning.

The next most effective and most accessed learning tools were the facility to download lecture notes from Blackboard and the ability to reinforce learning through multiple choice quizzes and

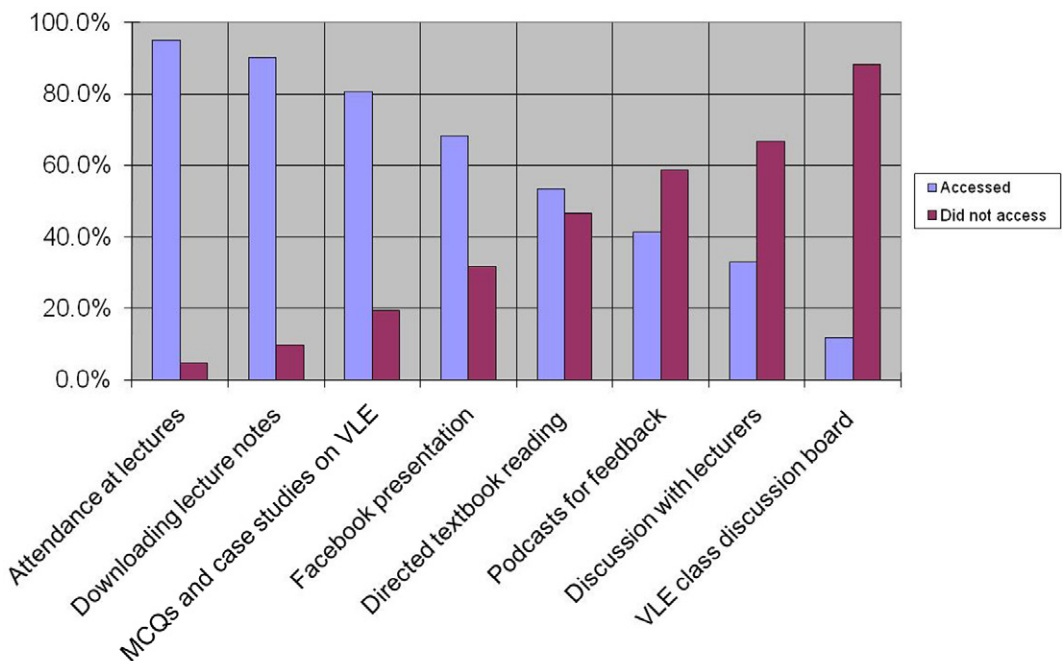


Figure 3: Percentage of respondents accessing various course features (MCQ, multiple choice question; VLE, virtual learning environment)

Table 1: Overall ranking of effectiveness of various technology tools

<i>Learning tool</i>	<i>Student ranking of effectiveness</i>
Lecture attendance	1
Downloading lecture notes	2
Multiple choice quizzes and case studies on VLE	3
Directed textbook reading	4
1:1 discussions with lecturers	5
Accessing podcasts for feedback	6
Facebook poster presentation	7
VLE class discussion board	8

VLE, virtual learning environment.

case-study analysis. This was a clear demonstration of strategic learning by the cohort as the format of both multiple choice questions and case-study analysis would be replicated in the end of semester exam.

Less popular but still accessed by a majority of respondents were the textbook directed reading and interaction with the Facebook course group. Sixty-eight per cent of respondents used Facebook to view each others coursework, to comment on it and to invite other friends to view it. However, Facebook's effectiveness as a learning tool was ranked seventh out of eight by the cohort. The additional comments section of the questionnaire also revealed that a proportion of students were not convinced of the usefulness of Facebook as a site for a virtual poster presentation. These students would have preferred to see the posters remain in the Blackboard environment.

Forty per cent of respondents accessed the podcasts and just over 30% took the opportunity to have 1:1 discussions with the course lecturers. The effectiveness of the 1:1 discussions with lecturers and the podcasts were broadly similar in terms of effectiveness as a student learning tool being ranked fifth and sixth out of eight respectively.

Only a small minority engaged with the VLE-based discussion boards and it was ranked lowest in terms of effectiveness as a learning tool. When faced with a range of communication options, it would seem that students prefer to ask a question face to face to a lecturer at the end of a lecture rather than to post a question on a public discussion board.

Support for the authors' hypothesis that the use of the VLE enhanced the student learning experience was overwhelmingly positive. Eighty-four per cent of respondents agreed or strongly agreed that the use of the VLE had enhanced the student learning experience. Only 2.1% disagreed with this statement. Survey comments such as "Very impressed with how much material there is online to enhance and help prepare for the exam" and "I think the use of Blackboard and Web 2.0 tools on this course is very good and useful. Much better than the other modules we are doing" were generally positive towards the authors' use of learning technology. However, the comments still show a propensity for strategic learning in that the most commonly posted comment was a request to make the multiple choice quizzes repeatable to aid exam preparation. There were a number of negative comments posted too, for example, "technology shouldn't take away from face-to-face contact with lecturers" and "stick to lectures this isn't supposed to be a distance learning programme." There were also a small number of respondents who described the VLE variously as "clunky" and "not user friendly."

The students' response to the question "should the course lecturers' use of the VLE be extended to other courses at The University of Manchester?" was emphatic too. Ninety per cent of students

agreed or strongly agreed that the use of the VLE should be replicated in other courses, with only 1.4% disagreeing with this statement. While it may be argued that the phrasing of this question was somewhat leading, the response was still overwhelmingly positive.

Blackboard usage statistics

The standard tracking tool within Blackboard was used to generate student usage statistics. Over the complete semester there were a total of 4464 student Blackboard sessions, with an average session length of approximately 18 minutes. Figure 4 highlights the distribution of sessions over the semester—showing a noticeable spike in usage in the week preceding the exam in week 15. In addition average Blackboard session length increased from 7 minutes for weeks 1–14 to 40 minutes in week 15.

Analysis of the viewing of the various learning tools within Blackboard is provided in Figure 5. This graphic is broadly similar to the access patterns reported by the students in Figure 3 earlier, in that the majority of blackboard sessions were concerned with accessing lecture notes and completing multiple choice quizzes. It should be acknowledged, however, that simply recording the number of blackboard sessions does not differentiate between a student clicking on a tool and a student meaningfully engaging with that tool.

These statistics provide broad confirmation of the views expressed by students in the survey: that students are highly strategic in their learning and focus their attention on the tools most directly

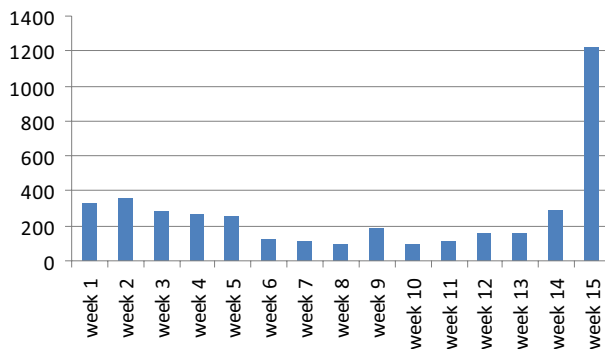


Figure 4: Number of Blackboard sessions per semester week

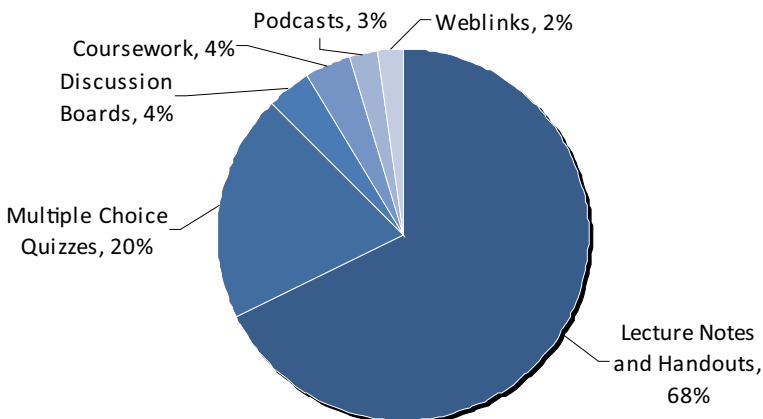


Figure 5: Percentage viewing of various Blackboard tools

related to passing the course unit. Indeed, the spike in Blackboard usage the day preceding the exam surprised even experienced teaching faculty.

Discussion

The findings of this study seem to confirm that the authors' use of the VLE together with additional Web 2.0 tools has enhanced the student learning experience in this large cohort management course. In particular, students ranked highly and used extensively the ability to download the lecture notes from the VLE and the provision of quizzes and case studies to test learning and aid exam preparation. Students were also decisive in their view that the technology did enhance their learning experience. However, students still ranked the keynote lectures as the most effective tool for learning. To make sense of this apparent dissonance, the findings of this study have been construed into broader constructs that can be used to inform current and future teaching practice.

Students as strategic learners

Both the survey and Blackboard usage statistics showed a strong student preference for the tools that were most explicitly aligned with delivering the desired course outcomes—ie, passing the course unit. These findings are congruent with earlier studies by Greasley *et al* (2004), Rogers (2004) and Moule *et al* (2010) on the effectiveness of the VLE as an extensive source of additional material and as a promoter of strategic learning. In a very large class the VLE provides an efficient mechanism for ensuring that all students gain access to all course material, even if they miss a lecture, and for allowing students to practise examples and test their understanding of material: tasks that are logistically difficult to achieve in a very large lecture theatre.

Interestingly, the evidence of this study does not point to student learning having yet moved decisively from a process centred on acquisition to one founded on participation as argued by Collis and Moonen (2001) and Mason and Rennie (2008). Students did not radically change their learning methods as a result of the provision of new technology tools, although the authors acknowledge that their use of learning technology was pragmatic rather than optimal (Patalong, 2003). The technology tools were very much grafted onto an existing course rather than forming an integral part of the course design. Had the authors radically redesigned the course and its assessment, learning technology may have played a more decisive role in altering student learning methods.

Pay attention to course design

In harnessing learning technology to enhance the student learning experience, this study provided further evidence that teaching faculty must pay close attention to the design of the learning activities. This study's mixed experience with discussion boards validates assertion of Wood and Henderson (2010) that learning outcomes and assessment criteria must be well thought out in advance to encourage usage of a particular learning tool. This is particularly important in a very large class, where minor mismatch between tool and task can lead to frustration and lack of engagement by students. Tools will only be used if they are perceived useful by students or if they are designed to form part of the students' assessment. For example, collaborative working to produce a group-based assessment might have been better implemented through the use of googledocs or a wiki as opposed to Facebook.

The relatively poor take up of the weekly podcasts was surprising to the authors, given previous work on the positive results of delivering feedback to engineering students using audio (Nortcliffe & Middleton, 2008). Only a minority of students (8.5% of the cohort) ranked podcasts as the most effective learning tool. For these students podcasts were perceived as an effective tool for learning, demonstrating perhaps that technology can start to address the wide range of learning

preferences inherent in a large cohort, and that different students will favour different methods of feedback. An alternative explanation is that the podcast delivery was uninspiring or that the one-size fits-all feedback did not add particular value to the majority of individual students. Podcasting will be continued next semester but only following further discussion with the next cohort over its content and format.

The findings of the survey also revealed a reticence among the student cohort to engage with the Facebook poster site. There are two possible reasons for this. Either it was due to the design of the assessment activity not requiring students to access Facebook until the assessment had been submitted or it lends weight to the notion that students view Facebook and other social networking sites as “their” space (Jones, Blackey, Fitzgibbon & Chew, 2010), a private domain in which teaching faculty is generally not welcome (Locke, 2007). The authors favour the latter conclusion and will not be repeating the use of Facebook in the next academic year.

Face-to-face interaction with teaching faculty remains paramount

It is clear too from this study that technology is not a panacea. The survey response showed emphatically that the most effective learning tool for the majority of students remained the keynote lectures. Technology was seen as an adjunct to the weekly keynote lectures and in no sense a replacement for it. This finding sits in broad agreement with previous research which reported that face-to-face contact with teaching faculty was valued most highly by students (Ipsos, 2007; Moule *et al.*, 2010).

Conclusions

The evidence of this case study supports the view that the use of Web 2.0 and the VLE can enhance the student learning experience in large cohort engineering management education. It confirms the assertion of Sharpe *et al.* (2006) that “Student response is overwhelmingly positive to the provision of online course information to supplement traditional teaching.” Technology alone, however, is not a sticking plaster for the challenges of large cohort teaching, especially if it is added incrementally to an existing course unit. Nevertheless, learning technology in this case study served as another weapon in the armoury of teaching faculty. It did enhance the student learning experience but for pragmatic reasons of accessing additional or missing course materials, and aiding exam preparation. This study also showed students to be highly strategic learners focusing time and attention on the tools that they saw as most useful to them. Students did not radically change their learning methods as a result of the provision of new technology tools, although there was some evidence in the use of podcasts that technology provided individual learners with more personalised tools for learning.

The authors acknowledge that more attention should have been paid to learning design in this case study and future work will be focused on this objective. The use of Web 2.0 as a vehicle for promoting collaborative learning will be further explored and course activities, both assessed and unassessed, redesigned to start to address the challenge of moving large cohort teaching from an acquisitive to a participative model of learning.

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