

Case study

An evaluation of a distributed learning system

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Keywords

Teachers, Computer-based training, Internet

Abstract

Presents an evaluation of a pioneering attempt to deliver a distributed learning Web-enabled system developed and piloted at RMIT University. Data were gathered from: a survey of students undertaking three undergraduate courses and one postgraduate course at one academic department at RMIT; in-depth focus group reviews; and lecturer summaries of their experience of using the DLS. One of these courses was offered to international students in Singapore as part of a mixed face-to-face and Web-delivery format. Results indicate that the DLS is generally popular with students. Difficulties were encountered with IT technical support and this provided an unnecessary level of frustration, however, results were generally encouraging. Concludes that the DLS needs to be more effectively used to support a more engaging learning experience and that students need to take more responsibility for their learning.

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Introduction

For some years now both academic institutions and industrial organisations have been anxious to encourage developments in the flexible delivery of education and training. In more recent years the potential for course content to be delivered via the Internet has attracted particular interest. Whilst there is an urgent need for robust investment in information and communication technology infrastructure to access digital information resources, high quality teaching and support to use this technology effectively and in creative and innovative ways must not be ignored (Dunkin, 2000). In a mass-market educational environment, twenty-first century IT delivery systems should be developed to achieve more effective and interactive teaching and learning outcomes, similar to those small discussion and tutorial group methods delivered at older, established universities during much of the twentieth century.

This article presents a case study to assess the experience, principally from a student perspective, of a pioneering attempt to deliver a distributed learning system (DLS), developed and piloted at Royal Melbourne Institute of Technology (RMIT) University. The paper is structured as follows. A brief introduction is provided of Web-based distributive learning system (DLS) technologies. This is followed by an introduction to the courses of study using these technologies in the Department of Building and Construction Economics at RMIT University (BCE). These two sections provide a basis for understanding the level of technology development and use at this time. The methodology used for the survey and the results are presented and discussed. Conclusions are then provided to present lessons learned and to indicate what further research needs to be completed to build upon our knowledge of the application of this technology and its impact upon student learning.

Distributed learning system technologies

One of the least effective modes of delivering opportunities for learning is the traditional

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lecture. Small group tutorial sessions provide a more conducive environment for interaction, discussion, reflection and questioning assumptions. Experimentation and direct action learning from hands-on application of problem solving is probably the most effective way for many to learn in a deep rather than superficial manner (Laurillard, 1993). There is, however, a need for learners to gain access to content and to have this material readily available as theoretical and instructional infrastructure in order to maximise the benefits from a more explorative approach to discovery and learning. Merely randomly experimenting or playing with games or other hands-on activity without prior exposure to theory is highly limiting in its educational effectiveness. The real value in learning is challenging assumptions and theory to discover under what conditions theory applies and why, compared to when it seems not to. Moreover, deeper learning occurs when conflict is encountered; requiring specific environmental factors to be deeply considered and their impact upon theory questioned and analysed. This occurs not only in an educational learning context but also in an organisational learning context (Kolb *et al.*, 1971; Argyris and Schön, 1978, 1996; Senge, 1992; Laurillard, 1993; Pedler *et al.*, 1996; Polanyi, 1997; Prusak, 1997; Limerick *et al.*, 1998).

It becomes apparent from the above that much of what DLS and the concept of online learning offers is not so much learning, but rather learning infrastructure and learning facilitation. There are real advantages to technology-based delivery systems over, for example, the traditional lecture format. In other courses offered by BCE (but not discussed in this paper), VHS video format and (more lately) CD-ROM and streamed video format materials, such as taped lectures/presentations and explanations, are used. These technologies have been found to be very useful in allowing students to see building technologies explained at close quarters, see examples of construction methods on-site (filmed), and to see simulation or animation examples that further reinforce principles or theory (Walker and Vines, 1997). The principal advantage of these technologies has essentially been to bring a student from the back of a large classroom or auditorium to the front row where illustrations can be provided in an easy-to-see manner. Whilst this increases the effectiveness of material delivery, it also facilitates better access to theory and practice

of examples provided on-site or from simulated experience.

Books, journal articles and class notes also provide source material for theory. Again, these provide infrastructure for learning and not learning itself. Libraries and handout notes have been the usual mechanism for gaining access to this source of theory. All of these delivery forms can also be effectively distributed via the Internet. The use of electronic journals, for example, has been gaining wider use by academic staff and students and has provided a powerful “value-adding” to learning infrastructures when combined with effective search engines. The Internet is thus facilitating a potentially improved infrastructure for gaining access to theory on a 24-hour, seven-day-a-week timeframe through access to electronic libraries, down-loadable class-notes PowerPoint slides that may include self-paced tutorials – not to mention the amount of public domain information available.

The Internet also provides interactive tools that can be used to make teaching and learning a more engaging activity closer to the small-group tutorial model that has been shown to be a more effective environment for learning than lectures (Laurillard, 1993). A recent useful guide for using the Internet for distance learning (Boticario and Gaudioso, 2000) includes additional needs:

- interactivity;
- providing quick, efficient and personalised access; and
- promoting the use of small working groups where participants interact.

The interesting aspect of their paper was the use of an interface portal that provides a split screen with links to recommended secondary sources of information and discussion groups when participants undertake problem-solving exercises. When we add some of the other facilities that a DLS or WebCT™ tools offer (bulletin boards, online conferencing, chat rooms, quizzes, individual and group e-mail access and other communication facilities) we can see that the Internet provides a potentially powerful learning infrastructure that can simulate a small group tutorial experience.

Much of the advantage of these technologies can be unravelled by poor infrastructure technology provision and support. Bradley and Woodling (2000), for example, draw attention to the need for facility management to provide reliable communications technology. In discussing

how collaboration between knowledge workers can be facilitated they argue that:

The comparative advantage of intelligent communities will be influenced greatly by the quality of available communications, in particular the density of high-bandwidth cellular radio to support increasingly information-intensive mobile business connections (including video interactivity).

This applies to education providers also, particularly when much of our customer base comes from part-time professionals in the workplace with Internet access from work and increasingly from home. Support for access includes not only bandwidth issues but also design of materials available from the Internet requiring support for Java, JavaScript, plug-ins and other programs and facilities that may impede access (Whittington, 2000). The main danger to be addressed is that e-courses must avoid being merely distance learning via the Internet with electronic materials replacing the packets of hardcopy notes that was a feature of the “old distance education” experience (Saunders and Weible, 1999).

The distributed learning system at RMIT University BCE

The distributed learning system (DLS) at RMIT Department of Building and Construction Economics was implemented in 1999 to:

- assist teaching teams to develop a more student-centred approach to teaching and learning using appropriate combinations of conventional campus-based approaches and online technologies;
- to build an infrastructure that would allow teaching teams to locally develop and deliver cost-effective and educationally sound online subjects and courses that could then be distributed across the University.
- provide a “one-stop-shop” for all teachers and students who want to work online as part of the total RMIT learning experience.

The DLS achieves these objectives by providing a software toolset enabling staff to deliver courseware via the Internet. Such delivery may include material dissemination, interactive problem solving, and group work, chat sessions etc., tailored to the requirements of any particular course. In the first semester of 2000, the Department of Building and

Construction Economics at RMIT delivered four courses utilising the DLS.

The BE560 Design Economics and Cost Planning (onshore) course is a component of the Bachelor of Construction Management program. This course is delivered onshore at RMIT’s City Melbourne campus. It comprises two distinct modules: Cost Planning (two-thirds of the course by assessment) and Introduction to Financial Feasibility (one-third of the course by assessment). In 2000, 73 students were enrolled in semester one – the majority being enrolled full-time. This cohort is considered as traditional, comprising predominantly young (under 25) full-time undergraduate students. The cost planning component of the course was delivered in traditional face-to-face lecture format, whilst the financial feasibility component was delivered predominantly via the DLS, with three supplementary face-to-face sessions. The online component comprised self-paced learning materials and tutorials, discussion boards and quiz/review questions. This component of the course was assessed by formal examination.

BE560 Design Economics and Cost Planning (offshore) course is also part of the Bachelor of Construction Management program but delivered in Singapore. In 2000, 65 students were enrolled. The program is delivered in block mode (one course delivered over two weeks during evenings), and designed to cater for students who are in full-time employment. The student cohort is considered to be older comprising predominantly 25–35 year-olds who are all in full-time employment. The course comprises two distinct modules as indicated above for the onshore course.

The material content and method of delivery was similar for both the onshore and offshore courses. The only difference being the number of face-to-face sessions held to support the online program – three for the onshore cohort, as opposed to one for the offshore cohort.

BG570 Construction Planning 1 (onshore) course is also a part of the Bachelor of Construction Management program. The subject is delivered onshore at RMIT’s Melbourne campus. In 2000, 144 students were enrolled to take the course. Of these, the majority enrolled on a full-time basis. The student cohort is considered to be traditional comprising predominantly young (under 25) full-time undergraduate students. The course comprises two distinct modules: Planning and Scheduling Theory (50 per cent of subject by

assessment) and Estimating Project Time and Cost – Practical Exercises Utilising Computerised Systems (50 per cent of subject by assessment).

The Planning and Scheduling component of the course was delivered in traditional face-to-face format. The Time and Cost Estimating component was delivered predominantly online with one introductory face-to-face session, six computer laboratory tutorial sessions, and numerous personal group consultations by appointment. The online component comprised exercise background notes, lecture materials, computer program tutorials and topic-specific discussion forum help facility. The assessment of this component of the subject was by a major group assignment of two parts and an individual learning record.

The BM213 Project Management Techniques course is a component of the Master of Project Management program. The subject is delivered onshore at RMIT's Melbourne campus. In 2000, 27 students were enrolled to take the subject in semester one. The majority were enrolled on a part-time basis. The program is delivered primarily in the evenings to cater for students who are all in full-time employment. However, a number of Saturday full-day sessions are arranged to replace some of the evening classes. The student cohort is considered to be older comprising predominantly 25-35+ year-olds who are in full-time employment. This course is "badged" with a similar one offered by RMIT's Faculty of Engineering so that engineering students enrolled on PM213 actually take part with the BCE students enrolled in BM213 as a single group. This badging caused technical DLS delivery problems in semester one (obviated when the subject was offered again in semester two) as will be discussed later.

For each of the above courses, enrolled students were provided with access to the DLS "Learning Hub" or simply "Hub" as it is commonly referred to. Students can access the Hub either from within RMIT or any Internet connection in the world. By entering their student number and password they can enter into a customised virtual workspace for each of the courses they are enrolled upon. This workspace provides access to:

- the "classroom" where notices are posted on bulletin boards;
- learning materials;
- e-mail access to within-group, within-class, and to lecturer(s); and

- links to external sources defined by the course lecturer such as electronic library access or to Web sites of interest.

Files can also be deposited and downloaded for student-to-student, lecturer-to-student or student-to-lecturer access. These electronic files can be in any form – sound, video, text, PowerPoint slides, images or program routines. There is also provision for quiz/tests to be placed in the "classroom". The system is highly versatile and designed to be user friendly. The appearance provides a Web site feel and is similar to many of the commercial available learning template systems.

Evaluation methodology

The purpose of the evaluation of these courses was to assess the effectiveness of the DLS as a medium for courseware delivery through the identification of relevant strengths and weaknesses, from both student and lecturer perspectives. Specifically, the evaluation was concerned with issues of access to and use of the system, and the facilitation of teaching and learning.

In order to undertake the evaluation, three methods of data collection were utilised as follows:

- (1) *Survey*. A seven-point Likert scale survey was undertaken within each of the course cohorts. Additionally, the survey asked students to provide comments on their perceived advantages, disadvantages and suggested improvements to the DLS.
- (2) *Focus groups*. In-depth interviews and discussions were undertaken with representatives from two course cohorts.
- (3) *Lecturer summaries*. Summaries were prepared by each of the course lecturers identifying their perceptions of the strengths and weaknesses of the DLS system.

The course lecturers identified their perceptions of strengths and weaknesses of the DLS system as reported to them by students in conversations or via e-mails and other avenues of expression. Each course lecturer prepared individual summaries.

Results and discussion

Student survey

The response rate of the survey for each subject was as follows:

- BE560 Design Economics and Cost Planning (onshore) 51 per cent ($n = 73$);
- BE560 Design Economics and Cost Planning (offshore) 18 per cent ($n = 65$);
- BG570 Construction Planning 1 34 per cent ($n = 144$);
- BM213 Project Management Techniques 63 per cent ($n = 27$).

The survey contained 15 statements (see Tables AI-AXV in Appendix 1 for the question asked) requiring a ranked response and an open-ended section where they could state what they liked and disliked about the DLS and to suggest improvements. Each statement was presented separately together with the subject responses and comment.

Results were consolidated into three categories plus provision for a “no response” result to the particular question. The data are provided in percentage response terms.

It is interesting that only a small proportion of the offshore students responded. The course lecturer felt that Singaporean students did not respond to the survey principally as a matter of face. It was evident that many did not access the Internet but simply had friends download files and then pass around the hardcopy notes to classmates. This was also the case with other subjects not included in this survey. In the main, this can be explained by two factors. First, despite the rhetoric in the Singapore press to the effect that Singapore is a high Internet use society, evidence suggests the reality is otherwise. Many of our students, when questioned, had little exposure to such technology. Second, the Internet transmission speed from Australia appears to be slow for many students in Singapore.

Response from the postgraduate class students was surprisingly high given that for the first two-thirds of the course duration – over half of the class could not access the subject on the Hub due to RMIT technology difficulties.

Results from the 15 questions provide useful insights into the students’ perceived learning experiences. Results for Table AI indicate the majority of respondents found it easy to access the Hub. Approximately half of the undergraduate students agreed it was easy to access the Hub, although approximately one-third disagreed. However, there was less agreement amongst the postgraduate students who were evenly split as to the ease of access to the Hub. Table AII indicates that the issue of registration was not a major problem for the undergraduate students, although the figures for the offshore students are higher

than for onshore. Table AIII indicates that the majority of undergraduate students did not have password problems. Interestingly, the results for BE560 (onshore) and BE570 differ markedly (10.8 per cent and 20.4 per cent respectively had password problems), although this was the same student cohort, using the same password. Almost one-third of respondents experienced the Hub network access being frequently down (Table AIV). This was greatest in the undergraduate offshore and postgraduate categories. This may be due to both of these cohorts accessing the network mainly “out of hours” when maintenance is being performed. Table AV indicates that undergraduate onshore students had greater problems with the capabilities of their own computers than the offshore and postgraduate students. This is most likely due to greater use of workplace computing equipment (often with more power than home computers), by the offshore and postgraduate students. Table AVI strongly indicates that confusion over how to access the learning Hub was greater with the onshore undergraduate students, and minimal to non-existent with the offshore and postgraduate students respectively. This could be due to different lecturers providing instruction regarding Hub access that the students possibly found confusing.

We were interested in the more convenient way that students could access the Hub so we placed a direct link to it via the BCE home page. Table AVII indicates that by far the greatest access to the Hub for undergraduate students was via the Department’s homepage. The majority of postgraduate students, however, did not use the Department’s homepage to access the Hub. This may have been due to different instructions having been given as to Hub access across the different cohorts. Table AVIII indicates clearly that the majority of students did not use the RMIT electronic library links, although 25 per cent of all respondents used the links. The postgraduate students were more likely to use this facility. This is disappointing as students were encouraged to seek a wide variety of texts, papers and alternative perspectives on issues addressed in the courses. This indicates a reliance on handout materials, which indicates a lack of depth of study through time or other reasons.

The data from Tables AI to AVIII demonstrate the DLS concept as providing a useful way of gaining 24-hour access on a seven-day-a-week basis when it is not bedevilled by technical delivery problems.

While the RMIT delivery experience requires improvement it is encouraging. The offshore delivery issue of pipe-size may be corrected as more countries improve their cabling and IT infrastructure. There is evidence indicated in these results that companies and organisations should encourage their employees to make more use of the Internet for professional development.

Table AIX indicates that the majority of students found the “classroom” layout to be user friendly and easy to navigate. However, the results varied between cohorts, with a high level of agreement amongst the offshore students, but less so amongst the onshore students, both undergraduate and postgraduate. It is difficult to reconcile these differences, except to comment that the offshore students may have received greater tuition in navigating the Hub. Table AX indicates that the majority of students found it easy to download files, although the onshore undergraduate students experienced more difficulties in this regard. This may well be due to their lack of computer hardware power as determined earlier. It is interesting that Table AXI indicates that almost a third of students were not satisfied with the time taken to download files. The higher dissatisfaction amongst the onshore undergraduate students may reflect their comparative lack of computer hardware power. Table AXII indicates that the majority of onshore undergraduate students found file sizes a problem, as compared with a minority of the offshore and postgraduate students. The size of files, mainly PowerPoint files compressed as Acrobat portable data files (PDFs) with images embedded in many slides, helps to explain the higher levels of disagreement amongst onshore undergraduate students’ responses. Table AXIII indicates that clearly the majority of students found the explanations about file content useful. Table AXIV reveals interesting results in response variations between course cohorts in terms of finding out how the downloaded files were used – possibly due to the explanations and notes contained in each course. This question was not included in the survey in the BM213 course so the postgraduate students’ response is unknown. Clearly the majority of undergraduate students used the online classroom to print out material, as opposed to engaging with it on the computer.

Table AXV indicates that generally students were evenly split with respect to their impressions toward online learning. However, responses were polarised by cohort type. The

offshore and postgraduate students were clearly favourably impressed with the application of online learning. The majority of onshore undergraduate students were not impressed with the application of online learning in their educational experience. This could well be due to the different contexts and expectations of each. The offshore and postgraduate students, almost all being more mature in age and in full-time employment, may find the online system more compatible with their needs. The onshore students, on campus, perhaps view the online system as a poor substitution for face-to-face methods of delivery that they are accustomed to.

In terms of comments offered by students from the unstructured questions the responses are encouraging. They seemed to like the ability to use materials from the Hub at their own pace and at times convenient to them. Ease of access was also commented upon as opposed to developing their own notes (the PowerPoint files provide excellent revision materials). However, from a pedagogical perspective there is a lot of value in students summarising notes themselves (Laurillard, 1993). Comments about suggested improvements centred around technical difficulties, mainly the DLS being frequently unavailable. There were consistent demands for more face-to-face and tutorials, suggesting that many respondents value:

- human contact and availability for *ad hoc* questions to be answered;
- the opportunity to raise specific points to be clarified; and
- for a generally more interactive learning experience.

Evidently there are mixed feelings indicating that while online learning benefits are recognised there is a perceived need to maintain the human contact through face-to-face delivery and small group interaction. The survey respondents did not comment upon how such tools may be used to meet these needs such as online conferences because those tools had not been piloted for the period under question.

Focus groups

Two focus group sessions were held; one with four of the undergraduate onshore students who undertook the BE560 and BG570 subjects. The other focus group was held with three of the undergraduate offshore students who undertook the BE560 subject. The outcomes of the focus group sessions are presented in Tables AXVI and AXVII (see

Appendix 2), and are summarised in terms of the positives and negatives of the online learning experience, and the suggested improvements of the groups.

The survey results and comments given from the unstructured section of that questionnaire and the focus group discussion all appear, in the main, to support each other.

Course lecturer summaries

The course lecturers identified their perceptions of strengths and weaknesses of the DLS system as reported to them by students in conversations or via e-mails and other avenues of expression. Each course lecturer prepared individual summaries. Course lecturers' comments are summarised to provide their interpretation of the data in the light of their experience of the DLS delivery approach.

BE560 Design Economics and Cost Planning (Onshore). Approximately 30 per cent of the students failed the online feasibility component. This is twice as high than in previous years. It would seem evident that there is a link between this result and the introduction of the online delivery mode for this component. Whilst this has proved successful in Singapore, this does not appear to be the same for the onshore-based students. Whilst face-to-face sessions were provided to assist, little use was made of the discussion boards etc. It seems that the first use of this delivery mode has contributed greatly to this result. The students are not accustomed to it and many faced time management problems – possibly leaving the work until the last minute. To overcome this problem next year, face-to-face review sessions will be used at consistent stages throughout the semester. Perhaps some form assessment could be incorporated into these. Additionally, greater use will need to be made of the discussion boards etc.

BE560 Design Economics and Cost Planning (Offshore). The online component proved reasonably successful, although 14 students (17.5 per cent) failed to complete the component successfully on the first attempt. Further, only 37.5 per cent of the students accessed the Web site, down from 46 per cent the previous semester. This figure incorporates those whose friends probably printed off all of the notes and gave them to them. The lack of access to the Web site is perhaps the most worrying issue. However, over 80 per cent passed the online component via formal examination, so something is working.

BG570 Construction Planning 1. This course component has been previously delivered using minimal (three) face-to-face briefing lectures and three computer laboratory tutorial sessions. Students' primary task involved the remote completion of a major two-part group assignment with consultation time being

provided by appointment with the lecturer. It was the lecture-remote nature of the subject that indicated its suitability as a transitional project for the department's online learning implementation strategy. Although pass rates were consistent with previous years, there was a general reduction in the standard of submissions. Students were instructed and encouraged, through the introductory lecture and various notices and handouts, to use the online learning system to access lecture materials and for communications. There was, however, overall minimal usage of the online system by most students. The topic-specific discussion forum help facility was only used four times despite continuous urging for this to be the main medium for communication. Student e-mails were the preferred method of online communication with the lecturer. Many students appeared to still require and desire some directional motivation or timetabled lecture regime to undertake their studies. This perhaps indicates a lack of personal responsibility being taken that may reflect the age and maturity of the students, their culture values or previous educational experiences.

Students seemed to be seduced by their apparent release from formal lecture time constraints and the perceived total online availability of lecture materials into postponing their learning and assessment tasks. Consequently there were, compared to previous years, a higher number of requests for submission deadline extensions and a considerably higher number of personal consultations, especially towards the end of the semester. This may be a factor resulting in the general lower submission standards compared to previous years.

BM 213 Project Management Techniques. Initially the DLS was a complete disaster for at least 50 per cent of students due to their inability to gain access to the Hub. They were essentially locked out due to being enrolled in a linked or "badged" subject PM213. In semester two these problems were finally resolved though some still had problems with password access prevailed. With no technical IT support from after 5p.m., postgraduate students were very critical of the treatment they receive (i.e. none) in getting after-hours IT support help. In terms of content and delivery for those gaining access to the Hub, the feedback was very positive. They see it as a great adjunct and support system but were adamant that they would not like to substitute online learning for class contact in any major way for core content – workshop activities and some tutorial work would be fine using Hub.

Conclusions

This paper began with a brief discussion on the use of online delivery for academic courses of study. The pedagogical theory

stresses that student interaction with the work, and the internalisation of knowledge and experience that this engenders, is of paramount importance when designing and implementing an improvement in the delivery of educational courses (Laurillard, 1993). An ideal situation would still seem to favour the ancient apprentice and master approach where the student is guided by a mentor who allows the student to experiment and to learn from problem solving and active participation in testing theory with practice. Much of the knowledge management theory stresses the importance of converting tacit knowledge into explicit knowledge (Polanyi, 1997; Sveiby, 1997; Garvin, 1998). The university system, however, is facing the problem of delivering mass education and attempting to provide the quality of experience that was hitherto only available at the wealthy old traditional universities such as the USA Ivy League universities or at “Oxbridge” in the UK. The compromises of the mass education system have been seen to be significant – large classes attending lectures and larger than desired tutorial groups being the norm despite their effectiveness being seriously questioned. The resulting action to compensate for this has been that many, if not most, universities are now turning to technology to assist with the provision of an improved educational experience. Universities such as RMIT are investing heavily in technology support and adopting an e-commerce approach with a “open all hours” solution in mind.

Academics involved in BCE and others at RMIT have expressed concerns that technology delivery is merely being seen as a substitution education technology for teaching and student interaction. The new vice chancellor in her inaugural speech stressed the need for universities to focus on connections, alliances and a more network approach to view students and academic staff as joint partners in an educational experience where IT technology is used as an enabler (Dunkin, 2000). Whilst in many ways a sound approach, it would be easy to underestimate the implications of developing content and providing and supporting the necessary technology. Further, difficulties must be overcome in changing the mindset of students who often see themselves as receptacles receiving wisdom from teaching staff rather than being responsible searchers of wisdom – gathering ideas from theory and being responsible for testing these against practice, then drawing their own conclusions and reconfiguring their mental models. This latter

point is critical yet poorly addressed. Data gathered from this survey, particularly relating to survey comments and course lecturers’ comments, illustrate the point.

The evaluation of the DLS has highlighted clear advantages with this method of subject delivery. Clearly major strengths have been identified such as:

- flexibility, where students can learn when and where they wish;
- the self-paced nature provides an environment conducive to “deeper” learning;
- greater learning empowerment to the student provides an environment conducive to “deeper” learning, by enabling students to undertake and chart their own problem solving;
- improvement of general information technology literacy amongst students.

However, a number of inhibitors have also been identified which require attention in an endeavour to improve the educational experience offered to students through this mode of delivery. These inhibitors are listed in Table I, together with suggested actions for improvement.

The introduction of the DLS system has provided the Department of Building and Construction Economics at RMIT University with additional opportunities for course delivery that provides support materials online on a 24-hour-a-day and seven-days-a-week basis. Survey data indicate that access to the DLS and IT support present a significant irritant. However, the design of the courseware, the ability to easily download support materials (including those from the electronic library resources) are appreciated and provide students with the theory and support materials necessary to begin theory testing and reframing of mental models. Limited use has been made of arguably the most effective DLS tools, that is tools that provide interaction between students, student to academic staff, and tools that facilitate simulation, playing and testing/quizzing routines. Further research on implementation of these tools is needed once these tools are more widely in use.

Perhaps the most under-researched and under-discussed aspect that is evident from this research is the issue of student maturity; how tools such as the DLS can encourage students to become more empowered to take more responsibility to explore the greater range of theory resources available; and how to take a more active role in practical activities and

Table I Inhibitors and suggested action

Inhibitor	Suggested action
Course material design not compatible with the mode of delivery to create an interactive learning experience	Greater training provided to staff with respect to the educational attributes of online delivery and the requirements of design of course materials in response
The perception of online learning as a "poor relation" to face-to-face delivery	Use of online learning as augmentation for, as opposed to replacement of, face-to-face mode of delivery
Lack of lecturer/student interface	Mix of online/face-to-face delivery to be promoted
Greater cognisance required of students' computer hardware capabilities when designing materials	Design and/or refurbishment of subject materials by lecturers. Advice and guidance required from DLS staff
Lack of student instruction required regarding system access.	Formalised instruction of system usage provided on a departmental basis, in conjunction with DLS staff and support materials
Lack of instant feedback, which may be a learning impediment	Use of timetabled, specifically focused, online chat sessions
Registration of offshore and postgraduate students	Improvement process from DLS
Lack of out-of-hours technical support	Provision of help-desk and other out-of-hours support
"Down" time of system	Improved process from DLS
Password problems for postgraduate students	Improved interface of RMIT systems from DLS

experimentation to test theory against practice. This could be the next step in our journey to improve the educational experience of students.

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Appendix 1

Table AI Statement 1

I found it easy to get into the RMIT online Learning Hub				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	59.5	21.6	18.9	0.0
BE560 (U/G offshore)	53.8	0.0	30.8	15.4
BG570 (U/G)	46.9	10.2	38.8	4.1
BM213 (P/G)	40.0	0.0	40.0	20.0
Weighted average	50.9	11.4	31.6	6.1

Table AII Statement 2

I had trouble getting into the "Hub" because of not being originally registered				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	5.4	5.4	70.3	18.9
BE560 (U/G offshore)	15.4	0.0	69.2	15.4
BG570 (U/G)	8.2	8.2	65.3	18.4
BM213 (P/G)	33.3	0.0	53.3	13.3
Weighted average	11.4	5.3	65.8	17.6

Table AIII Statement 3

I had trouble getting into the "Hub" because of password difficulties				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	10.8	5.4	62.2	21.6
BE560 (U/G offshore)	23.1	7.7	53.8	15.4
BG570 (U/G)	20.4	6.1	57.1	16.3
BM213 (P/G)	46.7	6.7	33.3	13.3
Weighted average	21.0	6.1	55.3	17.5

Table AIV Statement 4

I had trouble getting into the "Hub" because of the "Hub" network access being frequently down				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	27.0	10.8	45.9	16.2
BE560 (U/G offshore)	53.8	7.7	30.8	7.7
BG570 (U/G)	26.5	14.3	51.0	8.2
BM213 (P/G)	40.0	6.7	33.3	20.0
Weighted average	31.5	11.4	44.7	12.3

Table AV Statement 5

I had trouble getting into the "Hub" because of my own computer/network not supporting access				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	24.3	5.4	48.6	21.6
BE560 (U/G offshore)	7.7	7.7	69.2	15.4
BG570 (U/G)	22.4	16.3	44.9	16.3
BM213 (P/G)	0.0	0.0	73.3	26.7
Weighted average	18.4	9.6	52.6	19.3

Table AVI Statement 6

I had trouble getting into the "Hub" because of being confused how to get into the Hub				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	16.2	8.1	59.5	16.2
BE560 (U/G offshore)	7.7	15.4	61.5	15.4
BG570 (U/G)	32.7	4.1	51.0	12.2
BM213 (P/G)	0.0	20.0	60.0	20.0
Weighted average	20.2	8.8	56.1	14.9

Table AVII Statement 7

I used the Department of Building and Construction Economics Web page to gain access to the "Hub"				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	73.0	0.0	13.5	13.5
BE560 (U/G offshore)	61.5	7.7	30.8	0.0
BG570 (U/G)	53.1	8.2	28.6	10.2
BM213 (P/G)	20.0	0.0	60.0	20.0
Weighted average	56.2	4.4	28.1	11.4

Table AVIII Statement 8

I used the RMIT electronic library links				
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	18.9	13.5	56.8	10.8
BE560 (U/G offshore)	15.4	7.7	61.5	15.4
BG570 (U/G)	24.5	10.2	46.9	18.4
BM213 (P/G)	26.7	6.7	33.3	33.3
Weighted average	21.9	10.5	50.0	17.5

Table AIX Statement 9

	I found the layout of the "classroom" in the Hub user friendly and easy to get access to where I wanted to be			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	54.1	21.6	21.6	2.7
BE560 (U/G offshore)	92.3	0.0	7.7	0.0
BG570 (U/G)	46.9	12.2	30.6	10.2
BM213 (P/G)	60.0	0.0	20.0	20.0
Weighted average	56.1	12.3	23.7	7.9

Table AX Statement 10

	I found it easy to download files			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	54.1	16.2	29.7	0.0
BE560 (U/G offshore)	61.5	23.1	15.4	0.0
BG570 (U/G)	40.8	18.4	32.7	8.2
BM213 (P/G)	53.3	26.7	13.3	6.7
Weighted average	49.1	19.3	27.2	4.4

Table AXI Statement 11

	I was satisfied with the time taken to download files			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	54.1	16.2	29.7	0.0
BE560 (U/G offshore)	30.8	46.2	23.1	0.0
BG570 (U/G)	40.8	14.3	38.8	6.1
BM213 (P/G)	50.0	25.0	18.8	6.3
Weighted average	45.2	20.0	31.4	3.4

Table AXII Statement 12

	I found file sizes a problem when downloading files			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	21.6	10.8	64.9	2.7
BE560 (U/G offshore)	53.8	15.4	23.1	7.7
BG570 (U/G)	30.6	12.2	49.0	8.2
BM213 (P/G)	60.0	6.7	20.0	13.3
Weighted average	34.2	11.4	47.4	7.0

Table AXIII Statement 13

	I found the explanations about file content in the classroom useful			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	51.4	29.7	16.2	2.7
BE560 (U/G offshore)	76.9	23.1	0.0	0.0
BG570 (U/G)	36.7	18.4	38.8	6.1
BM213 (P/G)	53.3	13.3	26.7	6.7
Weighted average	48.2	21.9	25.4	4.4

Table AXIV Statement 14

	I only used the online classroom to print out material as opposed to viewing it on the computer			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	54.1	24.3	21.6	0.0
BE560 (U/G offshore)	69.2	23.1	7.7	0.0
BG570 (U/G)	53.1	12.2	30.6	4.1
BM213 (P/G)	n/a	n/a	n/a	n/a
Weighted average	55.6	18.1	24.3	2.1

Table AXV Statement 15

	I was favourably impressed with the application of online learning for this subject to facilitate my learning			
	Agree (%)	Neutral (%)	Disagree (%)	No response (%)
BE560 (U/G)	32.4	18.9	45.9	2.7
BE560 (U/G offshore)	84.6	15.4	0.0	0.0
BG570 (U/G)	26.5	22.4	46.9	4.1
BM213 (P/G)	60.0	13.3	20.0	6.7
Weighted average	39.4	19.3	37.7	3.5

Appendix 2

Table AXVI Summary of focus group 1

Focus group 1 – four undergraduate onshore students – BE560 and BG570 courses	
Positives	Negatives
Do the sessions at any time	Feedback is not instantaneous which can lead to discontinuous study and breaks in concentration
Do the sessions at one's own pace, with the ability to go back over things, or investigate things more deeply	Interpretation of material by students may be incorrect
Improves computer literacy	Flexibility reduced if access from home is not possible due to lack of computer equipment
Develops adaptability in students to deal with "new" situations	System is frequently "down"
Can lead to greater understanding of issues as students forced to find their own answers or meaning	Perception that students are paying for a face-to-face course, and the online version is a cheaper alternative
Greater inter-group discussion (in the computer lab)	Material is not explicit enough
Quizzes a very effective learning tool	Material simply printed out once and studied in hard copy, which may be contra to educational intent
A more useful and user-friendly resource for subjects than the Department intranet	Leads to problems in terms of time management
Suggested improvements	
Combine face-to-face tutorial sessions with online delivery	
Introduce milestone face-to-face sessions throughout the semester	
Improve access and reliability of the system	
Utilise timetabled synchronous chat sessions	

Table AXVII Summary of focus group 2

Focus group 2 - three undergraduate offshore students – BE560 course	
Positives	Negatives
Flexibility to do the sessions at any time at one's own pace, which suits a hectic lifestyle	Design of material is critical as an ambiguity can halt a student's progress and enthusiasm for the program
More empowerment to learn by providing the opportunity/necessity to pursue the answer to problems oneself, often leading to a greater understanding	Material needs to have more real life examples to support it, as is provided in the face-to-face context
Improves interaction between the whole student group via the discussion board, informal discussions etc.	Access at times a problem
Works well when "blended" with face-to-face delivery	Student time management is critical
	Timing of the program needs to be considered with assessment requirements for other subjects
Suggested improvements	
Provide more real life examples to support the material	
Possibly introduce milestones that force the students to pace their way through the program, to avoid the last minute rush. Perhaps this could be done with timetabled synchronous chat sessions, say one per week with each week covering the next topic	
Improve access and reliability of the system	