A FRAMEWORK FOR A CYBER CLASSROOM: TOWARDS A HUMAN-CENTRIC VIRTUAL CLASSROOM

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ABSTRACT

Many tradition teaching environments rely mainly on synchronously delivering, sharing, and interacting with learners. Learning is more asynchronous but is connected to teaching. The 'holy grail' of contemporary learning and teaching is to create that same traditional classroom feel within a virtual environment but use the power of e-communications and digital resources to enrich e-teaching and e-learning for solitary and collective learners. This paper describes an action learning approach to enhancing these environments to become more digital so that all students no matter where they are can avail themselves of the resources usually only available on-campus. The next step is a human-centric virtual classroom. The paper describes the possibilities and pitfalls of applying digital technologies to close the 'soft' information gap between on- and off-campus accounting students in a digital environment.

Keywords: e-Learning, e-Teaching, Virtual Learning Environments, e-Learning Technologies and Systems, e-Learning Evaluation, Accounting Education
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1. INTRODUCTION

Most of today's teaching in higher education is undertaken in an environment that can be described as synchronous. Students sit in a classroom with the lecturer out front imparting information (or is it data). At some point the lecturer decides to ask a question. Where the class is made up of English-literate, self-starter students, the lecture might a response or two. This is real time synchronous two-way communication found in a traditional teaching environment.

The act of learning tends to be more asynchronous but is connected to teaching [1]. Many students learn from their books, notes and sometimes a course web site trying to make sense of concepts while undertaking study activities. Some of these activities are assessed (summative) while others are more formative. In a number of cases, interaction may occur between some students through digital chat sessions on the Internet. Rarely do many students approach their lecturer for help as they fear being thought as 'dumb' or even ostracised. Thus traditional learning usually takes place in an off-line, asynchronous, solitary environment with little communication between students and lecturer.

What if we had an environment that could be synchronous all the time? How would teaching and learning change? Would it have an impact on students' education and how lecturers interact with them? What would such an education environment look like? Technology and the Internet would be used in such a contemporary learning setting but have we the robust technology to handle an open, real-time, synchronous teaching and learning environment that is not so complex that only 'techies' can operate in it? Is a 100% digital environment possible in teaching and learning?

These are some of the questions that the 'Dynamic Education' project has attempted to address over the last three years (2007-2009) using an action learning methodology and will be reported in this paper. It leads to the conclusion that we still have a long way to go to achieve the 'holy grail' of contemporary learning and teaching to create that same traditional feel within a digital environment but use the power of e-communications and digital resources to enrich e-teaching and e-learning for solitary and collective learners. This paper describes the application of a number of digital technologies and media adopted to close the 'soft' information gap identified between on-campus and off-campus students at an Australian university. Closing this gap was the main driving force behind undertaking the Dynamic Education project. Among the technologies tested and applied, the key ones were tablet PCs, video/audio/text digital recording of all on-campus sessions, multi-media resources, wireless devices, smart-whiteboards, and clickers (Keepads). In terms of e-communications, some of the technologies and software used, besides the Internet, were Mediasite streaming PC, WebCT/Moodle, Camtasia, Elluminate, and Wimba. The paper discusses possibilities and pitfalls of digital technologies to move closer to the 'holy grail' of a human-centric virtual classroom where all learners and lecturers can e-learn and e-collaborate in a 100% digital environment. Before describing the project and its outcomes, the paper first describes the motivation, framework and methodological approach.

2. MOTIVATION

The university has a number of overseas campuses where their programs are delivered either by ex-pat and/or local staff. Having taught on a campus in China (2006), it became obvious that there was a wide gap in the information received by on- and off-campus students. Subsequent to joining the university it was imperative that something be done to close the gap. During the second semester of 2006, the course in question was re-written to fit the needs of the School as students were not getting sufficient basic accounting skills. This lack of a foundation in accounting caused problems for advanced courses that relied on Financial Accounting Systems (FAS) as a pre/co-requisite. The new course design was implemented in first semester of 2007. During this semester, a two (now three) years plan was developed and implemented to change the supporting resources and pedagogies used to take advantage of enhanced teaching and learning technologies. Some design change had to be made to the revised course as research shows that a traditional face-to-face course can not simply be converted to an on-line, student-centred course [2], [3].

Thus the main goal of this study is to reduce the 'soft' information gap that was identified as existing in what was being provided to on- and off-campus students. By closing the

gap, students can be more equitably treated and the introduction of digital resources provided significant resources to enhance students' learning, progression and grades. Evidence from formal evaluations and informal feedback from students provided here supports this proposition.

3. PHILOSOPHICAL FRAMEWORK

Not all students adopt the same learning style or styles. Using a student-centred approach requires lecturers to embrace a variety of learning styles so students can choose those that are most appropriate to them [4], [5]. In addition, not all students are on-campus creating the potential for an information gap which may create inequities. The framework that underpins this study is based on the author's teaching and learning philosophy which has been developed from the Confucian approach: ***I hear and I forget. I see and I remember. I do and I understand.*** The author's teaching and learning philosophy can be summed up in the following statement: ***Enquire by reading, learn by doing, understand by practising***. The framework used for the project has been adapted from Kathleen McKinney [6] as cited in Littrell [9]. Some pedagogies evaluated and adopted (in **bold**) using the framework are:

1. **evaluation of pre-requisite knowledge** using a diagnostic quiz with feedback and revision material;
2. use of multimedia, streamed and recorded sessions to **present material in an engaging way for different learning styles**;
3. **present verbal material in more than one way and use many examples**, all of which are captured in digital form to reduce the 'soft' information gap;
4. **make use of technology to vary modes of teaching**, and for synchronous and asynchronous learning;
5. **adjusting delivery of content** through the use of technology feedback devices **providing alternative learning sequences**;
6. **use of several diverse forms of assessment** (exams both practice and real, e-portfolios, projects, group work in virtual space, quizzes, presentations both live and virtual, case studies, discussion topics, assignments);
7. **provide diverse out-of-class learning opportunities to practise** and gain feedback enabling mastery.

4. METHODOLOGY

In selecting a methodology to use for this study, one is careful to understand the possible bias that it may introduce. As the area of education technology is still evolving particularly as applied to the teaching of accounting, it would be spurious to adopt a positivistic approach where there are no theoretical proven concepts [8], [9]. Drawing on research undertaken in information systems, investigations of phenomena are concerned with the development, use and impacts of systems in organisations and society [10]. This positivistic approach tries to predict and explain a phenomenon so that causal relationships can be identified [11]. At the other end of the spectrum, an interpretative approach seeks knowledge of reality through social interaction, documents and other tools thus attempting to understand phenomena [12].

Thus this project adopts an interpretive qualitative framework that uses grounded theory through an action research methodology. It does not attempt to test hypotheses but draws on prior studies to frame the areas of knowledge that can be gained through social interaction between students and lecturers [13], [14]. Action research involves the researchers (lecturers) in combination with other organisational members (students) who together seek new knowledge and change processes for improvement [15]. To study a phenomenon using action research requires cyclical processes that involve design, implementation, observation, critical reflection and re-design where the cycle starts again [16]. This project commenced in first semester 2007 and cycled through six semester to semester three 2008. It involved nine separate lecturers (including the researcher) and over 1200 students. Below are the innovations and changes made based on a research directed plan.

5. DYNAMIC EDUCATION PROJECT DESIGN

Over an extended period, a project was undertaken (and is continuing in 2010) to evaluate the use of education technologies in teaching and learning accounting. Titled the Dynamic Education project, its goal is to reduce the gap in information provided to and obtained by external (distance, off-campus) students as compared to on-campus (full-time) students. Much information is imparted to on-campus students that are not captured for off-campus dissemination, described by the project as the 'soft' information. On-campus students capture 'soft' information by taking notes and participating in class. Off-campus students (including full-time students that have not attended the class and external students) are not there to capture what additional discourse has occurred and been verbally added to explain material on slides, written on a whiteboard, and responses made to students' questions by the lecturer – all 'soft' information. This situation may create inequities for students that do not have the advantage of accessing 'soft' information, creating a 'soft' information gap. Thus the Dynamic Education project was designed to redress this inequity and ensure that through the use of digital education technologies it would be possible to go beyond capturing 'soft' information to provide opportunities to include students in classes in real time no matter where they are located.

The Dynamic Education project is divided into three phases – Phase 1- Dynamic Teaching, Phase 2- Dynamic Learning, and Phase 3- Human-centric Virtual Classroom (HCVC). In Phase 1 (now completed), the main objectives were to:
- maximise student engagement through
  - moving teaching from a static process into a dynamic engagement with the learners;
  - reducing the information gap between on-campus and off-campus students through capturing the teaching/information imparted during class time – 'soft' information.

- move away from didactic theory where the tendency is to see teaching as the transmission of knowledge [17]; this helps to support the diverse student body and learning styles while at the same time increasing inclusivity for students with disabilities and barriers to learning [4].

- reduce collusion as it is a major issue when dealing with quantitatively based courses that make expansive use of computers and digital files; issues raised by [18] provided some insights for developing assessment items that are complimentary to learning.

Phase 2 (Dynamic Learning now completed) extended the findings from Phase 1 with the main objective to:
- maximise student interaction through
    - a pedagogy that facilitates dynamic engagement with learners;
    - introducing innovative pedagogies that provide a simulated on-campus learning experience for most students.

Phase 3 has not been completed. This Phase was to develop and implement a Human-centric Virtual Classroom (HCVC). The reason why this Phase has not been completed is discussed later in this paper. The main objective of Phase 3 is to:
- maximise student interaction and engagement through a virtual classroom environment which will provide the opportunity for students to attend the actual class session live (synchronously); those that can not, for time differences or other reasons, have the option to play the session in their own time (asynchronously) but still see and hear all the interaction that occurred.

6. OUTCOMES
6.1 Phase 1 – part (a)
Phase 1 extended over two semesters in 2007. During the first semester of (Phase 1 part (a)) for the undergraduate first year course in financial accounting systems, the following pedagogies were adopted. All class sessions (lectures, tutorials, and labs) were captured (audio, video and digital writing [e-ink]) through use of a variety of technologies; recording of class sessions were via video cameras onto tape which was then edited. All writing in class time was captured using a variety of technologies (tablet PCs, graphics tablet, PDAs, digital pens, digital paper) to test their efficacy. Recorded and edited sessions were uploaded to the course web site (StudyDesk in WebCT®) for access by all students. Some classes were also broadcasted from the university's TV studio to test this technology's effectiveness.

Students were provided with a set of slides that were incomplete (in the form of a 'dynamic classbook' Figure 1); during class, students were required to complete the slides and examples as the lecturer completed the slides (using e-ink on a tablet) with words and exercises. This was a way of introducing tactile participation which kept students engaged.
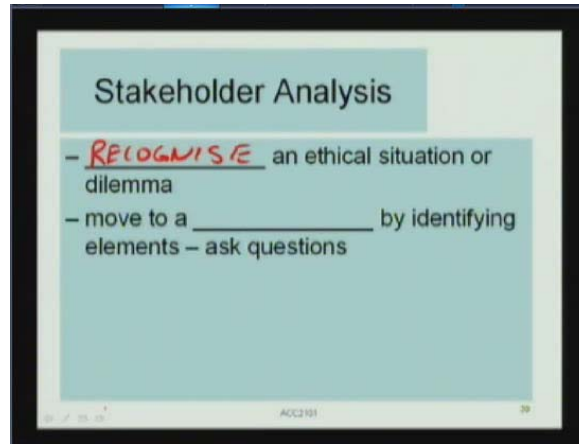
5

Figure 1. Dynamic classbook slide

At regular intervals during the lecture, two to three questions were asked to which students responded verbally. This was to provide feedback to students to gauge their own understanding but more importantly allowed the lecturer to see what was being understood and he could respond accordingly [19]. In tutorials and labs, a set of ten quiz questions were asked at the end of sessions to review past weeks' work to again identify areas that needed further work. This pedagogy commenced the move away from static teaching (delivering a lecture) to dynamic (student engagement and dynamically changing the delivery). To attempt to overcome the inequity issue between on- and off-campus students, these questions and answers were recorded along with the lecture material presented. In addition, a set of randomly generated quiz questions were developed and made available each week via the StudyDesk (course web site) using WebCT®, so that all students had additional opportunities to test their understanding, gaining instant feedback including pointers to revision materials.

Students had access to the textbook's web site that contained a digital version of the text (which the lecturer annotated identifying important areas), as well as quizzes, extra exercises and some solutions. Course website (StudyDesk) was enhanced to include a number of resources such as slides for each module, completed slides with e-ink (after the end of a session), assignments, and instructions as well as solutions to assignment questions. In addition, students were required to submit their assignments as digital files into an electronic dropbox.

6.2 Critical reflection – Phase 1 part (a)

PowerPoint slides, which are usually static plus any annotations written on the whiteboard and aural explanation, were captured in digital form. This was well received by students particularly those that were not in the class (see below for feedback). However there were some issues that needed attention.

Capturing class session on video tape and then editing was a time consuming post-class exercise; every 30 minutes of recording took almost two hours to edit and convert (render) to a digital format so it could be uploaded to the StudyDesk. An alternative had to be found to digitally record sessions from the outset. Part way through the semester,

digital conversion and editing was abandoned and tapes were made available in the library, which were not readily accessible to off-campus students.

Broadcasting the class from the TV studio proved popular as students at a distance had an opportunity to ask questions while viewing the session across the Internet. These questions came in the form of e-mails direct into the studio where the lecturer answered verbally on camera. Thus synchronous communications needed to be developed further so that a valuable resource such as a studio is not tied up. A link was provided to the digital recording for playback on the StudyDesk.

Digital-ink technologies were evaluated and showed that the optimal devise was a tablet PC as it afforded the best support for the lecturer. Graphics tablets require viewing the computer screen while writing on the graphics tablet, quite a difficult task when completing numeric exercises and formulas. Digital pens and paper were equally difficult to use and slides had to be reproduced on the device before they could be annotated. PDAs were the least successful as it was only possible to progress slides without being able to annotate them even though each PDA had e-ink capability. One other issue identified was that the lecturer was chained to the front lectern where these devices were resting. This did not allow any flexibility of movement around the classroom without abandoning the tablet PC. Although audio was captured using radio lapel microphones while roaming, it was not possible to e-ink the slides or screen in any way once in another part of the room.

Classbooks that contained the incomplete PowerPoint slides were printed in landscape by students before a session. One column contained the slides and the other was blank so students could write notes. Student feedback at the end of semester indicated that there were too many pages to print. Alternative formats were required to reduce paper use but some students completed their slides on laptops during classes.

As expected, very few students responded verbally to the questions asked in class for many of the reasons identified in the literature [20], [21]. Traditional approaches to gaining feedback through the use of questions and quizzes have a lot to be desired. A technology-based solution that provides lecturers with a non-intrusive but effective pedagogy, was required [22].

One issue that was not incorporated into the research plan that was identified in this Phase of the study was that students appeared not to have the prerequisite knowledge for Financial Accounting Systems (FAS). Prerequisite courses included an introductory accounting course (financial and management accounting) and an introduction to computers (including Microsoft Office® applications) course, both of which all commerce students completed in their first semester. Of particular interest to FAS was the basic financial accounting concepts and use of Excel. Proficiency with the latter appeared particularly lacking.

Other digital resources caused problems for some students. For example, students had difficulties uploading assignments due to a lack of a Java plug-in that was required by

WebCT® (Vista 3). In addition, the text's web site was minimally used by students and needed to be more integrated with course materials.

6.3 Phase 1 – part (b)

Based on the feedback and critical reflection, the following pedagogies were evaluated for the first year course in financial accounting systems. All class sessions (lectures, tutorials, and labs) were digitally captured (audio, video and digital writing) through use of a variety of wireless technologies (tablet PCs, wireless local area network) to test their efficacy. Recorded sessions (using Camtasia® and Mediasite®) including all class activities (voice, video, annotations, questions and answers) were uploaded to the StudyDesk (in WebCT®) for access by all students, an asynchronous solution.

Commenced trialling live streaming synchronous lectures (as well as recording) using Elluminate®. This provided students with the ability to hear and see what was undertaken in a class session just as if the students were in the room but also allowed students to replay the session at their own pace and time. Introduced a variety of on-line quizzes and incorporated them as part of the formative and summative assessment items to increase active participation and engagement from students particularly from those students off-campus. This also enabled testing of pedagogy to reduce collusion on assignments and to test prerequisite knowledge.

6.4 Critical reflection – Phase 1 part (b)

Part (b) of Phase 1 was a consolidation of what had been learnt in part (a) while at the same time moving forward towards the ultimate goal of applying enhanced educational technologies to reduce the 'soft' information gap. It was also an opportunity to introduce tutors and other lecturers in the teaching team to some of the innovations. Again using the feedback from students (cited below) and peers as well as reflection on practices adopted, some further insights were achieved.

One of the major breakthroughs for this project was achieved in this part. The lecturer was unbounded from the front of the class which usually occurs with wired technology. Introducing wireless technology freed the presenter to roam the class knowing that he can write on a digital device while both the electronic ink and audio commentary were clearly captured. A wireless receiver box (Airporter) was attached to the video cable that usually plugs into a laptop (connected to the data projector). Using software located on the tablet PC, the screen was then wirelessly sent to the tablet in a local area network (LAN) environment. Thus while the lecturer was away from the front of the room, he could still write on the tablet PC and it would be projected onto the screen. Additional software was available to allow other wireless-enabled devices to connect with the receiver but this was not trialled at this Phase of the project. However, problems emerged very early in using a roaming tablet PC – weight and battery life. The Toshiba (Tecra M4) tablet that was initially used was quite weighty (over 2 kg) and the battery life was not long enough for a two or three hour class without some time on a charger. Adding a long life batter only exacerbated the weight problem even though it added extra battery life. To overcome both these issues, a Fujitsu (Stylistic ST) slate was adopted. A slate has no attached keyboard or CD/DVD drive and solid state disk space but has the same digital writing

capability as the tablet PC and with an A4 size screen. The weight is quite light (under one kilogram) and the battery life is up to six hours. Disadvantages of the slate over the tablet PC are that you need a Bluetooth keyboard and mouse plus external CD drive. Should these be needed in class, it is extra equipment to carry. It can't easily replace the laptop or desktop as can the tablet PC. Weighing up all the attributes, the slate was found to be the better device.

Considerable amount of time was saved by recording class sessions in digital format from the beginning of semester. Students also indicated that when they had viewed the unedited versions of sessions (in part (a)), they preferred them as unedited. In essence they did their own editing by playing the sections they wanted to see. To capture the screen, e-ink, and audio, Camtasia® and Mediasite® were used. Camtasia[1] is a screen capture software application that is commercially available. Mediasite[2] is a purpose built audio, video and screen capturing PC contained in one box that was originally purchased by the university to stream graduations. It has the advantage of live streaming as well as recording and storing sessions whereas Camtasia® only records. Recorded sessions were uploaded to the StudyDesk for asynchronous review. This allowed external students (as well as on-campus students that missed the lecture) access to a simulated on-campus experience while picking up the 'soft' information that they usually do not get to hear/see. This strategy was applied to address some equity issues between on- and off-campus students as well as provide alternative presentation options for different learners to use. Some concerns were expressed by students that the recorded files were too large for downloading. A range of file formats were trailed including WMV (Windows® media player) and MP3 (for audio only) but still an issue for students without broadband or with slow connections. However, there was no interaction with off-campus students possible (could not participate and ask questions during a live presentation) with Camtasia® and Mediasite®. Consequently, towards the end of this part of the project another software package (Elluminate®) was trialled that streamed and recorded while allowing students to ask questions synchronously (discussed in Phase 2). Elluminate® has the ability to stream and capture audio, screen, e-ink as well as video. Students were impressed with the fact that they could see the class and when they asked a question (and they had a webcam) the class could see them. The Mediasite® PC was easy to use but care had to be taken to set the input sources for audio and video as well as plug the radio microphone into the right socket. It was quite bulky to take to class in a wheeled-case and the author looked like a pack-mule going to class with this equipment plus tablet PC and notes. People that saw him thought he was going overseas on a extended teaching assignment or just coming back from one (this was said to him on a number of occasions).

To overcome the expressed desire by students to reduce the number of pages to print the classbook (lecture slides), alternative formats were trialled. Straight slide files, which could be printed in the form of handouts (2 to 6 slides a page), were the most popular.

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[1] For more information on Camtasia® visit
http://video.techsmith.com/camtasia/latest/edu/howto/enu/howto_cs4.html

[2] For details on Mediasite® visit http://www.sonicfoundry.com/mediasite/

However Adobe® pdf format that reduced the file size was also appreciated by students. Other formats were not so popular including reducing the size of the classbook. Even though the PowerPoint note format was in a small font size, students in class still managed to complete blanks in the slides as well as exercises as the lecturer e-inked slides during class.

Based on the interaction engendered (or not) in part (a) of Phase 1, it became obvious that more formative activities had to be incorporated into summative assessments. In addition, the lack of prerequisite knowledge and technological skills of students had to be addressed. To address the latter two issues, a diagnostic quiz was developed which contributed to the final grade. This was to be completed by week 3 (students were allowed 2 attempts) so that students evaluated how much they remembered from their prerequisite courses (introductions to accounting and computers) and the quiz provided pointers to revision materials. It was obvious that Excel skills were not sufficient to be able to complete a subsequent assignment well and some brushing up on financial accounting was also required. In addition, students were asked to answer some basic questions (based on material about course requirements such as finding when the next assignment was due). Answers to some questions were incorporated into a Word document and this was uploaded to an assignment dropbox on the StudyDesk. By having this document uploaded, it was possible to capture any technological problems (encountered in Phase (a)) with carrying out the upload procedure before the two remaining major assignments were due. This removed a lot of anxiety from students and frustration from markers. Weekly on-line randomised quizzes were introduced to allow students to check their understanding. Initially, these were voluntary and not graded. Following feedback from students and in evaluating effectiveness of the pedagogies adopted, changes were made to improve student participation and to enhance the learning experience. Students found completing quizzes each week as too heavy a load just for a few marks. This was addressed in Phase 2. Building these assessments items was one thing; marking was another. Thus as much as possible WebCT® was used to mark quizzes eliminating the need for lecturers and tutors to do so.

The two major assignments were based on an accounting case study of a golf driving range business. Prior to the redesign of the course, the assignment consisted of the students working their way through the accompanying workbook to learn MYOB® (an accounting software package) while completing transactions and producing reports. This they did basically in their own time throughout the semester and ended in submitting an assignment in paper form (plus their MYOB® data file) for marking. This marking exercise took close to two hour per students but the total allowance for all marking including exam was one and quarter hours. Initially (during part (a)), changes to this activity concentrated on laying the foundations of financial accounting through reducing the dominance of the technical aspects of the accounting software (MYOB®); students needed to fully understand the concepts before entering the data into a black box. This was achieved by first having students complete part of the MYOB® case manually and using Excel (the most used software in accounting). Then transactions were processed in MYOB® after undertaking two weeks of intensive training in the last half of the course. This approach had the benefits of building students' Excel® skills while underpinning

their MYOB® understanding with core accounting concepts. In part (b), the long marking time was tackled for two major assignments (Excel® and MYOB®). This was accomplished by using the capabilities of WebCT® to mark key results (accounting numbers) that students entered from their solutions but markers still needed to review the digital files (no paper submitted) to complete assessment of assignments. This process reduced the time to mark both assignments dramatically to less than one hour. Markers would review the key results marking completed automatically and then decide which areas of the submitted files they needed to look at to see where the student did not get the correct answer, giving part marks. In addition markers were required to give marks, based on a template, for formatting and other activities as part of the assignments. Using this pedagogy also provided students some feedback electronically as to whether their solution might be correct as correct balances and transactions were provided to them once they had entered their results. It also gave them the opportunity to review their solutions and re-submit their answers. Again, students gained faster feedback as the time to return assignments was reduced from three weeks to within 10 elapsed days. However this approach had some drawbacks as high achievers were concerned that some of their answers were not one hundred percent correct. Feedback of this kind was withdrawn in subsequent semesters as it was felt by students that it created more work for little gain in marks.

Having quantitative type assignments that are submitted in digital form has its drawbacks. Except for the first assignment, the other two assignments (Excel® and MYOB® based) were not only taking a long time to mark, delaying feedback to students, but there was collusion suspected and some identified (electronic files are easy to share). To make assignment 3 unique to each student an additional set of transactions were developed. These were set up as random quiz sets and required solutions to be calculated for marking. A detailed marking guide was provided for markers with over half of the marking being completed automatically. After implementing this strategy, no cases of collusion were reported. Some issues were encountered in relation to WebCT® handling such large quiz databases and to the need for alternate solutions, which required quite a number of hours of development. However, once set up considerable time was saved in subsequent semesters and time was only spent to add sets of transactions (and solutions) to expand the random options added to the original one hundred sets of transactions.

6.5 Student feedback – Phase 1

Student feedback during Phase 1 was positive. Some typical comments made by students on their evaluations at the end of semesters follow.

Very interactive lectures are a fantastic idea.

This is an acknowledgement that I am out here as an external student. I find the live lectures so necessary and thank you for the opportunity to be able to watch them via the internet.

I find viewing the lectures add a little extra to my learning by actually hearing the information in a different format and getting little bits of info you don't get in the

Study Book or text book which help your understanding a little bit more. The classbook tool is great!

Many thanks for the live lecture. I am external and being able to see this has made a big difference to my understanding. Many thanks.

In addition peer evaluation was undertaken of classes and feedback was reassuring.

In 2007, I reviewed one of Joseph's lectures for Financial Accounting Systems, where he was introducing some innovative teaching methods. These innovations involved capturing what is happening in the classroom using an 'interactive PowerPoint class book' as well as audio and video recording. Given that [university] has large cohorts of students enrolled through direct distance and partner institutions, these innovations have potential to benefit both off- and on-campus students

6.6 Phase 2
Following the success of and positive feedback from Phase 1 including the constructive criticism, additional technology enhancements were introduced in Phase 2 in keeping with the research plan.
- Technologies introduced in Phase 1 were extended for the same undergraduate course but with a different cohort of students through:
    - the use of PDAs, tablet PCs and other wireless equipment that on-campus students were provided so they were able to interact during learning and teaching events;
    - the use of feedback pedagogies and technologies to enable the instructor to poll the class to gauge their understanding of concepts and to adjust the delivery dynamically to enhance their learning (Keepad$^®$ [clickers] and Turning Point$^®$).
- New streaming and capturing technologies were applied to broadcast live and upload multi-media teaching and learning events onto the StudyDesk (WebCT$^®$-2007, Moodle$^®$-2008) using a Mediasite$^®$ PC, Elluminate$^®$ and Wimba$^®$ (an open source virtual classroom).
- Further integration of digital resources to provide a coordinated holistic design as opposed to disparate pieces including the incorporation of the text web-based resources such as MyAccountingLab$^®$ (a Pearson Education product).

6.7 Critical reflection Phase 2
Students were asked to participate in lectures and tutorials using appropriate technologies both wireless and wired. Although PDAs, graphics tables and other devices were trialled, the most effective were tablet/slate PCs. Students were invited to complete examples on the tablet/slate PC supplied by the lecturer. Some students that had their own laptops were encouraged to contribute to class activities accessing the main screen by the use of the WiFi receiver (Airporter) mentioned previously. The software allowed the lecturer to accept input from the whole class at once or an individual student while locking out the rest of the class. This made for a highly interactive session. Being able to sit or stand

anywhere in a classroom creates a more human-centred dialogue and presence rather than standing up front behind a lectern. Walking up to a student in the back of a room and placing a slate down in front of them on which they are asked to complete an exercise that is then displayed wirelessly on the front screen has great engagement power.

The greatest gain in Phase 2 came from the introduction of a student response system (SRS) using 'clickers'. There are a number of suppliers of SRSs however this study applied one of these, namely Keepad® from TurningPoint® Technologies[3]. Thanks to the generosity of the organisation, a set of clickers was introduced as a way of increasing the interaction in classes/labs. Students do not respond well to questions asked during sessions for fear of openly showing a lack of knowledge to peers and lecturer. Clickers provide an anonymous way to gain responses (Figure 2). At regular intervals during the lecture, two to three questions were asked to which students responded using a clicker. This provided students with feedback on their understanding but more importantly allowed the lecturer to dynamically change the presentation to reflect students' understanding. In tutes/labs clickers were used at end of a session to review past weeks' work to again identify areas that needed further revision. Detailed results of this study are reported elsewhere [22], [23]. It was intended to have appropriate software and hardware to gain responses from external and distant campus students. However the necessary equipment did not arrive on time from the USA. In order to gauge students' responses to the technology and their effectiveness in the dynamic learning process, the same set of questions were used in all sessions for all concepts across three semesters (Phase 1 (b), and Phase 2), with the third semester returning to asking questions without clickers. Use of clickers in class proved highly successful from both the lecturer's and students' points of views. Interaction increased and responses from students proved highly beneficial to dynamically change the presentation. Access to clickers (which were loaned for the study) was something worth pursuing however a technology needed to be found to allow off-campus students participating through streaming of the class, the ability to answer. This would further add to the perception that an external student was part of the virtual class. Towards the end of Phase 2 a new technology was identified that uses a mobile phone as a clicker so students can answer question in real time (without cost in Australia). This technology from John Wiley & Sons Australia Ltd[4] is being investigated.

To increase continuous participation in the course in keeping with the teaching philosophy (*learn by doing, understand by practising*), completion of quizzes, submission of student activities (SA) and discussion topics (DT) were included into summative assessments while allowing students choice of the number of activities they completed. To gain marks, students were required to submit a minimum of three quizzes, two SA and two DT evenly distributed across the semester. To minimise marking time, quizzes were marked automatically. Students were able to self-evaluate their understanding and gained instant feedback with reference to revision material. Having a choice of how many

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[3] The authors gratefully acknowledge the support provided by Keepad Interactive in supplying the hardware and software for the study. (www.keepad.com)

[4] The technology is called clickOn®.

activities a student undertook reduced the load by not having to compulsory complete all task to gain full marks (a criticism made in the earlier Phase). However a number of students did complete all activities and expressed gratitude for having such resources available (see feedback below). Although not statistically validated, there is some evidence that students who were highly active participants completing most activities and interacting on the StudyDesk with lecturers and peers, gained the highest marks overall. This is currently being investigated.
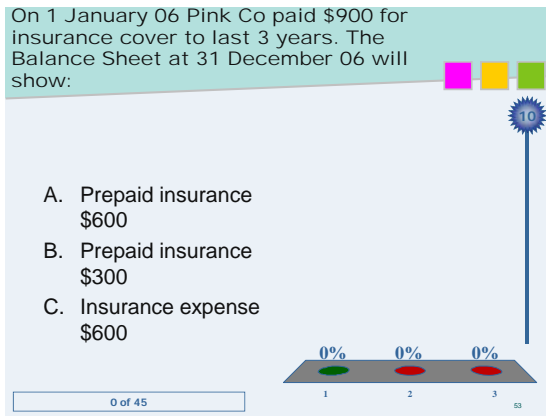
Figure 2a. Typical quiz question form
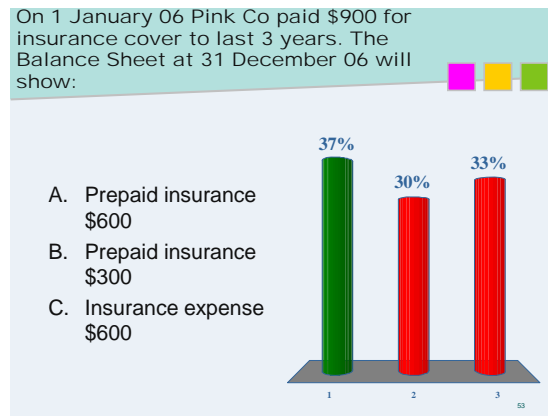
Figure 2b. Responses in % bar chart

Streaming and recording of all classes including tutorial/labs (where much more discussion occurred) were increased. The technologies that were applied for this were Mediasite® and Elluminate®. This provided students with the ability to hear and see what was undertaken in a class session just as if students were in the room but also allowed students to replay the session at their own pace, stopping at segments that they may not have understood the first time round. Elluminate® increased the interactivity for off-campus students viewing the sessions live, allowing them to ask questions just as in-class students could. As indicated earlier, when they asked questions, the video stream would show their face (if they had a webcam). Unfortunately the university only had a trial version of Elluminate®; thus it was not a sustainable alternative. As a result we commenced trialling an open source live classroom application to test its usefulness and usability as a replacement for Elluminate®. The Wimba® live classroom had almost the same features as Elluminate® but the additional benefit was that it could integrate easily with the new course management system that had been adopted by the university during 2008 (Moodle®). The application of Wimba® was extended across two semesters in 2008. It was relatively easy to set up and operate and students could be trained to use it in 15-20 minutes at the first live session. There were still some concerns expressed by students about the sizes of recorded files. Even though the Mediasite® PC-generated file could be viewed off the streaming server, students felt that it was using too much of their download allocation and delays were experienced. To reduce file size, an investigation of other possible recording alternatives was undertaken and a product was identified that

was developed at the same university in the engineering faculty called Caplec[5]. This software was tested and some improvements were suggested which were incorporated by the developer. The real advantage of this recording-only package (audio, video, and screen capture) was that it produced a file (for which it has its own player) one-tenth the size of a Windows® media file but had the option of producing an audio only (WMA) and a WMV file. It is by far the simplest user-friendly piece of recording software that was used in the project or has been identified anywhere.

Other pedagogical innovations introduced in this Phase were driven by problems encountered in teaching students from a non-English background and software they were not familiar with. To mainly help students these students, a multi-media glossary was developed to support the case study based on a golf driving range business used in assignments 2 and 3. From experiences in teaching the case in China, very few students knew anything about golf and the case required them to understand terminology such as iron, wood, shaft, head, and grip. The multi-media glossary includes video clips, images and text to explain and demonstrate the terms used in the golf case which makes the assignments easier to understand. Teaching software applications has its challenges. In order to be able to demonstrate the use of MYOB® over a two week period, an electronic whiteboard was used. This provides the lecturer the ability to display the computer screen on a large digital surface and control the software including input by touching/writing on the e-board. Not only can students present gain benefits from this technology but off-campus students can fully appreciate how to manipulate the software as sessions are all captured in recordings (being a digital device) just like writing on a tablet PC.

To improve and add to the resources available for the course, the web site of the prescribed text was integrated more deeply into the digital course materials. This was achieved in two ways. The study guide (called Study book) was pitted with links to the text web site. Thus by clicking on these links students had access to addition material for reference and completing exercises. The other innovation introduced was the incorporation of a new resource developed by Pearson Education called MyAccountingLab®[6]. This highly useful application provides students with exercises to complete on-line and once answered will do a walk-through of the solution adding audio commentary and step-by-step calculations from the point where an error occurred in their solution. This is extremely useful for external students as most are solitary learners, some of whom have no other support mechanisms around them let alone being in a different time zone to the lecturer, so asking questions and getting immediate feedback (even by email) is difficult. More use of this resource needs to be encouraged as a small number of students used it even though it was bundled with the text.

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[5] Caplec is not as yet commercially available as it is undergoing a patent application. Hopefully it will be available in 2009.

[6] Details on MyAccountingLab can be found at http://myaccountinglab.mathxl.com/login_acct.htm

6.8 Student feedback – Phase 2

Student feedback following the end of Phase 2 continued to be positive. Streamed and recorded class sessions were again seen as very useful.

> *As an external student the broadcast lectures are much appreciated. They motivate me to keep up with the study schedule.*

> *This is just to let you know that I have viewed the lecture regarding assignment 3 and as an external student found it helpful in filling in the bits of information I have missed esp as I have never used MYOB. I have watched it in bits over the last 2 days and am thankful such a resource is available.*

> *I think that the recorded lectures are great. I would be so lost without them. I wish that more of the other subjects would start recording their lectures as well. As an external student i feel that the recorded lectures just make the information sink in that little bit better.*

> *Loading lecture powerpoint slides onto the study desk is very helpful and also the lectures that can be viewed. As usual, the points made on the discussion board on various topics were also useful. Online quizzes to test knowledge at the end of semester was great.*

> *The content of this course was fantastic and well presented.*

> *I would like to say I have enjoyed the course and found it really relevant to what I'm doing in my life at the moment. Thanks for the help & support.*

> *The responses by the lecturer were designed to make you think rather than memorise, which I found particularly helpful in cementing this knowledge.*

In relation to the use of clickers, the students stated:

> *Never had so much fun in a class.*

> *Told me where I had to revise.*

> *I am sure most of you agree, that …. deserve a special thank you for delivering a course in such a way that makes accounting interesting - if that is possible. The resources that I have used through out this course have been fantastic and very helpful and I have not come across anything like this in any courses I have done before.*

When it came to the various formative and summative activities the students typically said:

Doing the weekly module activities. It helped in understanding the material better and helped in the assessments.

The student activities although tiome [sic] consuming made me sit down and do the activities week to week. The quizzes were also good.

Just want to say Thank you so much for your effort and help to make this course a very successful one. This is the best part of my studies so far. I've learned a lot on this subject and guaranteed that, i'm going to use this knowledge in the near future.

As a summary comment to Phase 2, students expressed their appreciation in a similar way to the statement that follows.

I am sure most of you agree, that (course co-leaders) *deserve a special thank you for delivering a course in such a way that makes accounting interesting – if that is possible. The resources that I have used through out this course have been fantastic and very helpful and I have not come across anything like this in any courses I have done before!! I am sure you will agree that they are both a credit to their faculty and university.*

7. PEDAGOGICAL DESIGN FOR ENHANCING ACCOUNTING COURSES

A number of pedagogies and technologies were trialled and adopted for the first year financial accounting systems (FAS) course. All were designed to meet the main goal of this project to close the 'soft' information gap plus enhance the student's learning experience. Activities were provided so students would have resources to strive for excellence. Figure 3 shows how the course design was changed and how the potential for excellence was generated. By providing recordings of sessions, quizzes, discussion topics, student exercises, and live classrooms in addition to the traditional feedback activities of assignments and exams, students could be elevated to accomplish better outcomes through consistent and regular engagement with the course. The base of resources and opportunities provided including text web-based resources, were clearly useful for students to learn and gain feedback in their own timeframe, particularly off-campus students who do not have face-to-face access to lecturers and tutors.

To add support to this approach, student results were summarized and compared before and after the changes that have been described in this paper (Table 1). These results show a reduction in the number of fails (from 14.8 to 9.2) and a higher percentage of passes as evidenced in other studies (for example Naser and Peel [24]). Of course this evidence can not be completely attributable to the interventions because they relate to different cohorts of students and different course designs. But when universities are seeking to increase progression and pass rates, it is a good outcome. More recent results show further improvements in failure rates as well as an increase in higher grades. As at the end of Phase 2, FAS was 95% digital, with only half the exam being completed on paper and marked manually.
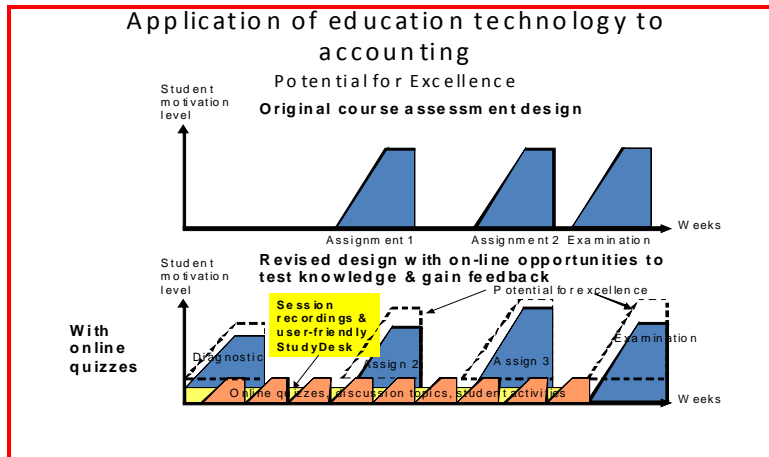
Figure 3. Application of enhanced education technology to accounting

Table 1. Grades before and after course re-design

	HD/A	B/C/D	F	Total No. Students
% Before*	24.47	48.78	14.82	1316
% After**	16.41	60.49	9.15	896

Percentages don't add to 100 as there are incomplete grades and other forms of non-completion that are not strictly fails but percentages were almost the same for both periods . *Results are for a two year period prior to the re-design. ** Results are from semester 1 2007 to semester 1 2008.

8. THE NEXT STEP – PITFALLS AND POSSIBILITIES

As stated earlier, Phase 3 was commenced in mid-2008 but was put on hold. This Phase was to develop and implement a Human-centric Virtual Classroom (HCVC). The reason why this Phase was not completed can now be explained. While undertaking the Dynamic Education project it was my intention to first trial pedagogies and enhanced technologies in one semester and then introduce them to other members of the course teaching team to use in following and subsequent semesters. Changes to the StudyDesk, including introduction of quizzes, electronic assignments submissions and marking, were accepted by other team members as it reduced marking time and they were not chasing paper-based submissions that could take a long time to arrive from far flung reaches of the world (one of the major reason for the delay in releasing results and feedback to students). Some basic training was delivered on the other technology-based innovations, such as clickers, recording of lectures, and even simultaneous transmission of classes across three campuses. The reaction from other team members, especially those at distant campuses was less than supportive. Similarly, introducing these innovations to other faculty colleagues in workshops and presentations, in the main, did not gain a lot of acceptance. Consequently, the decision was taken to postpone any further developments of Phase 3 until such technologies were perceived as useful and would be taken up by a number of teaching staff. This could only happen through simplification and integration of education technologies as well as being in a form that was unobtrusive. Some staff indicated that having to grapple with setting up the education technologies and monitoring whether it was working properly upset their traditional mode of delivery causing anxiety and loss of face. This was particularly the case when something went

wrong and they could not rectify it quickly. Anxiety can be caused by perceived cognitive barriers to technology so this also required us to understand what the barriers to adoption are.

> *You can have the best technology, the most advanced functionality possible, but if people don't want it - perhaps because they aren't equipped to use it - then it's in danger of falling flat.* [25]

As a result, a sub-project was formulated called Academic Interactive Dashboard (AID) to collect information on the barriers to technology acceptance as well as understand what level of education technology was being used in the university. Academics that are more technology savvy (innovators) can build sophisticated technology delivery platforms but they are in the minority, around three percent, with early adopters forming only an additional 10 to 20 % [26]. A solution is needed that is acceptable to the majority of academics if the whole approach is going to succeed. Taylor [27] cites Dolence and Norris [28] who argues that to survive into the information age, organisations needed to be "fast, flexible and fluid". In addition, as technology continues to advance and universities look to take advantage of them to respond to the dynamic changing nature of learning and their learners' desire to learn in their time and space, we need to find ways to overcome the hurdle of complexity.

This hurdle is common to all proponents of technology enhanced learning, irrespective of discipline or institution and thus a solution would have wide application. A number of reasons have been cited for this hurdle [3], [29], [30]. One key finding is that professional identity is a source of opposition but it can be turned into an agent for change [31]. To understand this phenomenon, Rogers' [32] diffusion of innovation model will be applied building on the work of Geoghegan [26] who used Rogers' model for education institutions. In addition, 'institutionalist' perspective model will be applied as it has been shown to provide a number of further insights [3]. The proposition to be evaluated for this sub-project was postulated by Jaffee [31] but apparently not tested:

> *that the receptivity and perceived legitimacy of new educational delivery modes is strongly related to the extent to which these instructional technologies reinforce or retain the central elements of the institutionalized and identity-enhancing classroom settings.*

Once we had a common understanding of the hurdles and technology needs of teaching staff (by survey and focus groups) at the university, the AID sub-project can be designed and pilot tested as an integrated system. AID will provide a set of basic controls that will integrate all the key learning technologies into one button on a touch screen in each classroom. Prior to coming to class, all technologies (computers, data projectors, cameras and others) and software application (PowerPoint, Excel, SPSS and so on) will be booked through the AID web interface (Figure 4). In addition, if the class is to be streamed and recorded, they can decide on the recording format including writing a DVD/CD for distribution to students that have limited or no Internet access, which has been identified as a problem [33]. AID will provide access to the key learning technologies lecturers

require to work in a real and virtual classroom environment without having to be concerned about the set up of technologies they are using.

Figure 4. AID web interface for booking requirements (in progress)

Technology innovations of this type are not developed in one day and nor by one person. It takes a team effort of technology specialists and academics. Although research funding was made available, it was limited. When it came to gaining technical support, this too was supported by top management[7]. However the professional staff were given the task to work on this project on top of their already heavy workloads. This meant that the project stalled on a number of occasions as it went to the bottom of the pile. As with most technology centred project, robustness of technologies is lacking. This causes many problems and delays as the research team tries to find a solution to the problem. This results in long hours being put into the project beyond what was expected and budgeted. Once you make the breakthrough you are ecstatic. But all our efforts are rewarded, no matter how small the gain, through acceptance and acknowledgments by students who really see the benefits. It is even more reassuring when more students pass.

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[7] All the support received for this project is acknowledged at the end of this paper.

Although not reported here in detail (as study is not complete), the survey and focus group discussions provided valuable information on the level of education technology literary and usage (which was assessed as low to average). This provided some evidence for the need for additional training and support for teaching staff if we are to achieve a higher level of usage of education technologies at a more advanced level beyond PowerPoint and converting paper-based learning materials to a web-based StudyDesk. On successful completion of the AID sub-project, the third Phase of the Dynamic Education project can be completed which will incorporate the first two phases but step up the interactivity through the use of multi-media communications technologies to build a human-centric virtual classroom. Studies undertake elsewhere have found that there is little research on the extent of resources and which of these resources students find useful [34]. This is currently being investigated (in yet another sub-project called Richness of Resources in e-Learning (RoReL)) to see if we can identify when and how students use these resources, to what extent, and if more engagement of a higher quality leads to better results. The following quote is apt:

> *It's frustrating living in the future, because you're waiting for everyone to catch up and get excited about it.* [35]

9. CONCLUSION

The intended virtual classroom will have the look, touch, feel, and interaction as if a distant student is in the actual classroom. It is then that we will have a truly dynamic learning and teaching environment for all our students, not just those on campus, perhaps getting closer to the 'holy grail' with enhancements. Universities must face the inevitable that the 'bricks-and-mortar' classroom are not the only way to deliver learning and may eventually give way to more virtual environments that are effective and student-centred.

However we need to overcome resistance to innovation and change, particularly in our education institutions if we are going to train teaching staff for the future. Modern education technologies appropriately adopted within a proven pedagogy can only enhance academics ability to deliver up to date knowledge using cutting edge technology. It is hoped that the project described in this paper will prompt other researchers to contribute to this area of study so that collectively we can find ways to overcome the barriers to adoption through simplification of education technologies. Our students will be the better for it and hopefully all will be treated equitably no matter where they are located and in what timeframe or mode they are studying.

It leads me to the conclusion that we still have a long way to go to achieve the 'holy grail' of contemporary learning and teaching to create that same traditional feel within a digital environment. Being able to take advantage of the power of e-communications and digital resources to enrich e-teaching and e-learning for solitary and collective learners is our challenge but presents many opportunities to one day have a 100% digital course available to all without the pitfalls and lots of possibilities.

10. ACKNOWLEDGEMENTS

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