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Click Go the Students, Click-Click-Click: The efficacy of a student response system for engaging students to improve feedback and performance

Joseph M Mula*
Faculty of Business, University of Southern Queensland, Australia
Email: mula@usq.edu.au

Marie Kavanagh
Faculty of Business, University of Southern Queensland, Australia
Email: kavanagh@usq.edu.au

Abstract

This paper uses an action research approach to examine the impact of phase two of a dynamic education project involving SRS technology on student learning outcomes. We examine the use of clickers or student response systems (SRS) as an educational tool in accounting. Both quantitative and qualitative methods are used to compare outcomes for students over three semesters in first year accounting classes. Results support an increase in the participation level of students in class, improved understanding of the course content and a positive learning experience. No correlation between in-class responses and overall assessment performance was found, but there was a decrease in the failure rate in the semester in which SRS technology was used. Overall, the study provides preliminary evidence of the efficacy of this technology to enhance student engagement and learning outcomes.

Key words: *Student response system; Pedagogy; Education technology; Student engagement; Feedback; Action research.*

** Author for Contact Dr Joseph M Mula, School of Accounting, Economic & Finance, USQ*

Introduction

How many academics have presented a lecture to a room of students over one, two, or three hours with little interaction or feedback to indicate how well the students understand the material presented? It would therefore be valuable to have some immediate feedback from each student about his or her level of understanding of the material being presented, rather than wait until final exam results, when it is too late to do something about it.

Teachers ask questions only to be answered (if at all) by the best students, while the timid, average or less articulate students just sit there even though they may not have understood. Some students do not respond to questions or requests for feedback due to the fact that even though they are physically in the classroom, their minds are somewhere else. Other students do not respond for fear of retribution, either from their fellow students or from the teacher whom they perceive may think of them as 'dumb'. Some students do not answer questions because they cannot put into words what is concerning them. Failure to articulate concerns could be due to being unsure of the relevant terminology to use, or in the case of many overseas students, a perception that they cannot express themselves adequately in English. Moreover, there is frequently a group of students that answer, or attempt to answer, every question, thereby dominating class discussions and leaving little chance for other less assertive students to respond. In addition, another group of students may simply fail to understand or follow the logic of the argument presented. All these groups are not necessarily mutually exclusive, and may share similar characteristics. In summary, it is not controversial to claim that many students in our classes may not be able to adequately follow the content delivered, particularly at the pace at which material is delivered in contemporary classrooms and courses.

This paper reports on a technology-based solution that has evolved into a feedback mechanism and provides instructors with a non-intrusive, effective pedagogy. This technology provides a method that can overcome many of the barriers presented above, while giving and gaining student feedback to dynamically modify delivery in the classroom. This may help focus on students' needs, as identified by students themselves. Variously described as 'clickers', audience response systems, personal response systems, group response systems, and student response systems (SRS), they have evolved as an effective technology in education and training, and have been popularised in TV game shows such as "Who wants to be a Millionaire" where the audience is asked to cast votes. Given that accounting educators are becoming more interested in the use of technology in their classrooms, and the investment in time and resources required, research investigating the impact of using this technology is timely. It could provide some insights to teachers on how to introduce quizzes using clicker technology in classrooms.

An action research approach was used to evaluate the implementation of SRS technology into accounting classrooms and conduct an experiment using student self reports and objective measures to test the success of the project. This research method was chosen to provide an iterative, systematic, analytic way to reflect on what was done in class, to evaluate success in achieving classroom goals, and to chart the direction of future classroom strategies to improve student learning (Cunningham, 2008). The study extends literature in the area in three ways. The project (1) compares students' general course perceptions with and without SRS, (2) examines the impact of immediate feedback provided by the use of SRS on students' understanding of the material being presented and (3) investigates changes in the level of student performance in assessments.

The remainder of the paper is organized as follows: the next section explains the overarching project that was designed to evaluate the use of educational technologies such as student response systems for teaching and learning in accounting courses. It then reviews prior literature, which has examined the effects of SRS on teaching and learning outcomes for students and staff, and frames research questions. This is followed by details of the research context and design and subsequent analysis of results. Finally, the paper discusses the findings, notes limitations and direction for future research, and provides conclusions.

Background to Student Response Systems Technology

Socrates over 2500 years ago, laid the foundation for effective pedagogy to instil in students the ability to think about a problem, establish a position and commit to a response as a way to promote learning (Stanford, 2005). In the 1980s, the Oxbridge tutorial system in the UK formally adopted this Socratic approach, exemplified by having a few students meet with their professor for small group discussion and debate. However, in our crowded classroom and lecture theatres, it is almost impossible to apply the Socratic approach effectively to actively involve each student all or most of the time (Abrahamson, 2006). With the improvements achieved in SRS technologies (and their variants), SRSs have increased in popularity in education and training in the last decade as a way of gaining feedback from students in real-time. One of the advantages of using the technology is that it maintains a student's anonymity (they can answer without being individually associated with the response, wrong or right) while allowing instructors to check progress of students' understanding. Commonly known as 'clickers' but broadly defined as Audience Response Systems (ARS), Personal Response Systems (PRS) or Classroom/Student Response Systems (CRS/SRS), the clickers themselves are remote response devices used to send students' responses to questions displayed from a computer. Typically, the technology involves a hand-held device (clicker) or wireless transmitter that uses radio frequency or infrared technology with an alpha-numeric keypad that allows students to respond to questions, which are usually in a multiple-choice format. Some systems allow responses in free-form text. The question is typically displayed as a PowerPoint slide that can be embedded in a normal slide set. Additional software that works in consort with PowerPoint, allows the design of the question slide to include feedback information such as graphical representation of responses.

Student responses are captured by an infrared or radio frequency receiver and software on a lecturer's computer. The computer software records responses and collates them into a database. In the study, 2 to 3 questions were asked at 15 to 20 minute intervals throughout the delivery of lectures. Results of the class' overall aggregate responses to questions are displayed to the audience in graphical form showing the percentages of correct and incorrect answers or number of responses to each multiple choice question. The main benefit is the instant feedback generated for the instructor and students. As a result of the feedback, an instructor can review what is not understood, provide an explanation for a misunderstood concept (EDUCAUSE, 2005), discuss additional examples to illustrate incorrect responses, or proceed on to the next part of the instruction if students comprehend the material tested. This use of SRSs (as applied in this study) can be loosely described as a 'formative' approach, where testing is used to provide instant feedback to students allowing them to judge how well they are understanding the material without being included as part of the assessment. However, many SRSs are used in a more 'summative' way, where answers are gathered at the end of a lecture or as a graded assessment item.

On completion of the class or classes, statistical analysis can be undertaken in a variety of ways using the software that was used to develop question formats. Analysis can be undertaken on a quiz or multiple quiz set to see if there is a pattern as to what concept(s) are being misunderstood. As each response is stored for every student (if identified through the device's electronic ID), comparisons can be made across the course for a particular student or across classes to see what progress has been made (Fan and Van Blink, 2006). In addition, analyses can be undertaken to see if there is an association between performance in quizzes (either formative or summative) and end of course examination or final grades.

Recent developments in SRS technology have improved the reach of this form of pedagogy. Enhancements are being made daily but one of most interest is the ability to have students on different campuses or on the Internet, respond to quiz questions at the same time as the students in the classroom with the instructor. Another variant of an SRS permits students to respond via their mobile phone or pocket PC/PDA. There are a number of suppliers of SRSs however this paper reports the application of one of these, namely ResponseCard® keypads and TurningPoint® software from Keepad Interactive1.

Figure 1:
Response Card (Clicker) & Receiver device

Literature Review

In 1989, the AECC was formed with the main objective being to foster profound changes in the education of accountants in order to better prepare them for successful careers in practice (Sundem, 1999). Since then, researchers, professional bodies and employers have repeatedly called for change in order to provide accounting students with learning experiences that demonstrate authentic practices and values of the accounting profession (AECC, 1990; Mathews, 1994; Adler and Milne, 1997). This has lead to questions being raised about the traditional methods of instruction that continue to dominate the pedagogical practices in accounting education and prompted academics to investigate the design and implementation of technology–enhanced learning environments (Muldoon, Jones, Loefoed and Beer, 2008).

According to research, students learn more and retain knowledge longer when they actively struggle with issues and problems than they do when they passively listen to lectures (Verner and Dickinson, 1967; McKeachie, 1967; Bligh, 1972; Eble, 1983). However, lecturing traditionally has been the overwhelming method of choice for undergraduate teaching in most institutions even though various forms of individualised instruction appear to enhance learning better than lecturing (Pascarella and Terenzini, 1991).

The concerns about feedback from students and maintaining their engagement in a classroom has been well researched and documented (Ames, 1992; Strong, Silver and Robinson, 1995). Solutions to these concerns have been variously attempted some with limited success (Fitch 2004). One approach was to use PowerPoint with the use of

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

graphics and animations in presentations to liven up the visual appeal and improve student recall (ChanLin, 1998; 2000; Lowry, 1999; Szabo and Hastings, 2000). Eventually it became gimmicky and passé as more presenters used similar libraries of images and transitions (Coursey, 2003). Much criticism was levelled at PowerPoint and this created anti-PowerPoint literature (Powell, 2005; Tufte, 2003a; 2003b). However, many believed that this approach to presentations was an advance on chalk boards, white boards and OHPs (Cassady, 1998; Gabriel, 2008; Perry and Perry, 1998; Susskind and Gurien, 1999; West, 1997). While PowerPoint is an effective way to stimulate one way communication between presenter and the audience, it does not really encourage the two-way interaction that an effective response system makes possible. In addition, research has found that traditional approaches to gaining feedback by asking questions and using paper-based quizzes leave a lot to be desired (Hoffman and Goodwin, 2006).

Evidence suggests that response systems date back to the 1960s with Stanford University installing a system in 1966 and Cornell University following in 1968 (Littauer, 1972). In this early incarnation, prior to the microprocessor, systems were used for tallying student responses in lectures with minimal application to promoting student interaction. Early tests showed that student feedback to their use was positive but no gains in students' achievement were obtained empirically (Bapst, 1971; Bessler and Nisbet, 1971; Judson and Sawada, 2002). During the 1980s, the Personal Response System (PRS) was developed. It was a 'wired' device that was used narrowly for marketing and entertainment. In the 1990s, Audience Response Systems (ARS) were introduced that were 'wireless'. This technological advance allowed wireless devices to be used more broadly in political poling and education. In the 1990s, education institutions commenced using Student Response Systems (SRS) or Group Response Systems (GRS) with positive effects. Empirical studies identified increased attendance by students to classes that used SRS devices and there was a positive attitude towards SRS-supported classes and systems (Fitch, 2004; Hatch et al., 2005; Beekes, 2006). With the development of and improvements to SRS technologies (and their variants), they have become simple, easy and reliable enough to gain broad attention (Beatty, 2004) leading to SRSs increasing in popularity in education and training as a way of gaining feedback in an anonymous manner from students in real time.

While the use of technology in the accounting classroom has become daily practice, empirical research with regard to the effectiveness of technology is surprisingly thin (Mcvay et al., 2007). Judson and Sawada (2002) found little evidence to support claims that use of GRS lead to benefits such as improvements in student satisfaction, engagement, exam performance and interaction. Carnaghan and Webb (2007) investigated GRS as an educational tool in a management accounting course. They found little evidence to support the claim that GRS leads to greater student satisfaction with the course and reduced engagement as proxied by student oral participation.

A possible reason for the 'no effect' results found in previous studies (Judson and Sawada, 2002; Carnaghan and Webb, 2007) may be that the focus of classroom technology has been one-sided, instructor to student. In a managerial accounting class, Edmonds and Edmonds (2008) found that students in the SRS classroom perform on average better than students in the non-SRS classroom and that the strongest positive influence is on students with the lowest prior GPAs.

According to Wines and Bianchi (2002), the classroom in which a personal response system is used is necessarily an active one such that in larger classes, where active learning is often very difficult to implement, its benefits become even more important. Indeed active learning is an internationally recognised cornerstone of the accounting education change movement (Lucas, 1997). Hwang et al. (2005) also found that cooperative learning amongst students is an effective teaching pedagogy for delivering accounting topics in a passive learning environment, but suggest that technology itself may not be sufficient to support and transform pedagogy. Edmonds (2005) also describes one of the main benefits of student response systems in accounting classes as being the motivation for students to pay attention in class.

Recently there has been considerable research on the implementation of SRSs (Elliot, 2003; Hall et al. 2002; Burnstein and Lederman, 2001) into economics, physics, and engineering classrooms. In a study with law students, Caron and Gely (2004) report that the use of this technology, in combination with other technologies and strategies, made it easier to infuse vigour into their classroom through active learning. Caron and Gely (2004), Tietz (2005) and Edmonds (2005) agree that if used successfully, clickers should enhance the classroom experience and student learning in the following ways:

- Make lectures and classes more engaging;
- Provide immediate feedback to the lecturer about students' understanding of concepts and topics;
- Provide immediate feedback to students about their own understanding of concepts and topics;
- Assist students to reinforce key concepts, draw connections to new material and build on previous knowledge.

Using these research studies' findings, the following research questions were formulated for this study.

RQ1: Did students perceive that the use of a student response system (SRS) during lectures and tutorials was a positive experience?

RQ2: Did students perceive that the use of a student response system (SRS) during lectures and tutorials improved their understanding of course materials presented?

RQ3: Did the level of participation of students increase in lectures and tutorials when a student response system (SRS) was used?

RQ4: Is there a difference between the performance in assessment between students who experience the use of SRS and those who did not?

The Context of the Research

To evaluate the use of education technologies in teaching and learning a project titled the Dynamic Education project is being conducted in a large regional Australian university with a large contingent of students studying via distance education. The goal of the project is to integrate technology to reduce the gap in information provided to and obtained by external (distance) students as compared to on-campus students. At present a great deal of information is still imparted to on-campus students but this information is not captured or recorded for off-campus dissemination, described by the project as the 'soft' information gap. 'Soft' information is defined as information and activities that are undertaken in classes that is not traditionally captured by all students. 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 to explain the dot-points on slides, what was written on a whiteboard, and what responses were made to students' questions by the instructor – all 'soft' information. This situation may create inequities for students that do not have the advantage of accessing 'soft' information. The Dynamic Education project commenced to redress this inequity. Through the use of digital education technologies, it is possible to go beyond capturing 'soft information' to provide opportunities to include students no matter where they are located while taking a teaching/learning session. Based on Lewin's (1948) 'action research spiral', the project's approach was to design a methodology that would build on previous learning and reflection, while allowing systematic evaluation and modification when appropriate. The Dynamic Education project is divided into three phases – Phase 1 - Dynamic Teaching, Phase 2 - Dynamic Learning, and Phase 3 - Human-Centric Virtual Classroom (Mula, 2008).

This study reports on Phase 2 -Dynamic Learning with the main objectives of this phase being (1) to maximise student interaction through a pedagogy that facilitated dynamic engagement with learners, and (2) to introduce innovative pedagogies that provide a simulated on-campus learning experience for all students. In keeping with the concept of dynamic engagement, the introduction of clickers was an important addition to the education technologies applied in the project during the Dynamic Learning Phase. The idea was to motivate students to be more active without taking too much class time, to promote student involvement that would make the class more interesting, and to move students away from rote learning and memorization toward a richer understanding of accounting and the bigger picture of which it is a part (Cunningham, 2008). To evaluate their efficacy, the clickers were used in lectures, labs and tutorials in the same undergraduate first-year accounting course offered over three semesters to three different cohorts of students.

In order to gauge students' responses to the technology and its effectiveness in the dynamic learning process, students who enrolled in semesters 1 and 3 did not use the SRS. Students enrolled in semester 2 did. However, the same set of questions was used in all semesters for all concepts across three semesters reported for this study. For the first and third semester, the questions were embedded into traditional presentations of PowerPoint slides in lectures. At regular intervals during the lecture, two to three questions were asked to which students responded verbally. This was to provide feedback to students of their understanding, but more importantly, allowed the instructor see if concepts presented were being understood (formative). 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 (summative). As expected, very few students responded verbally for many of the reasons identified in the literature (discussed earlier). 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 distributed each week via the StudyDesk using WebCT®, so that all students had additional feedback, including pointers to revision materials.

During the second semester of the study, clickers were introduced into the teaching and learning environments. The clickers were handed out at beginning of class and collected at the end. The same clicker was given to the student each time, so that at the end of semester some analysis could be undertaken to see if there was an association between students' correct responses and other marks achieved. At intervals of 15 to 20 minutes, two to four multiple choice questions were posed on the preceding 15-20 minutes lecture presentation (Figure 2a). This provided feedback to students on their understanding, but more importantly, allowed the lecturer to dynamically change the presentation to reflect students' understanding or misunderstanding. As each question was displayed, students had a set time to respond. Once the time elapsed, no student could add a response and the accumulated results from all students was displayed in a column graph, identifying the correct response with a percentage of the class that answered correctly and the percentage that chose each of the other incorrect choices to the multiple choice question (Figure 2b). In tutorials-labs, clickers were used at the end of each session to review work in order to identify areas that needed further revision. In this semester the reaction and response rate was much different (100% responded). By using clickers, all students had no inhibitions to respond as students' responses were anonymous. Data collated by the SRS technology provided full information on the class (around 40 to 50 students in a lecture session), and all student responses were captured allowing feedback about the level of understanding of the material. In lectures, the instructor was able to revisit concepts not understood over the last 15 to 20 minutes. This minimised the problem of progressing onto more advanced concepts without an understanding of foundation material.

Figure 2a:
Typical quiz questions

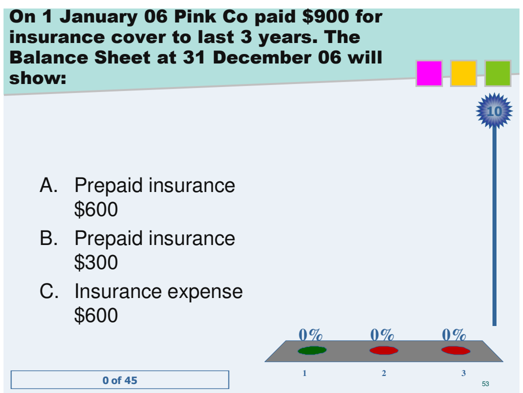
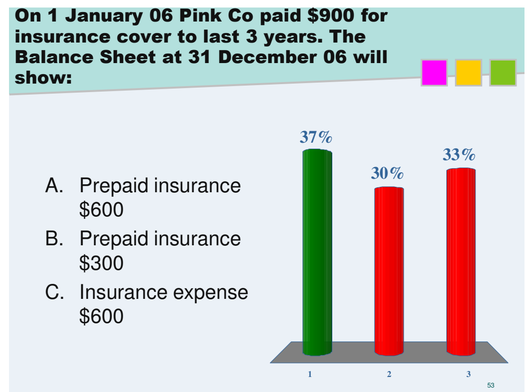


Figure 2b:
Responses in % bar chart form



For tutorials, students were given 10 to 15 multiple choice questions covering the topic delivered in the previous week. These questions were given as a set without any feedback until the end of the question set, but each question needed to be responded to within a time limit, usually 10 seconds. At the end of the question set, responses to each question were reviewed in graphical form. Again, this allowed the tutor to pinpoint any concepts not understood well by all students or a majority of students. Tutorials became more productive and focussed on students' needs rather than a few students who, under the traditional method, would ask questions or would not be reticent to verbally respond to multiple choice questions in a class environment.

As part of this undergraduate accounting course, students are introduced to the application of MYOB using a case study. Sessions are held in a PC lab where there is a smart-board (a digital whiteboard) as well as a virtual clicker system. The clicker keypad is displayed on the PC monitor and students can respond by selecting a number or alpha character as well as enter responses as free-form text using the keyboard. This system was used to test its efficacy in such an environment for teaching software applications. Students responded well to the vPad® (Figure 3) system (supplied by Keepad Interactive). Use of vPad® enhanced the interaction between tutor and students in demonstrating software by asking students to respond to questions at regular intervals. In addition, they could ask a question of their own anonymously by typing it into the vPad® using the keyboard.

Figure 3:
vPad®

Methodology

To address the research questions, data was collected from students involved in a first year accounting course offered over three semesters. Responses were received from 33, 61 and 26 students in semesters 1, 2 and 3 respectively. As a control, a SRS was used in semester 2 but not in semesters 1 and 3. Data was collected using class quizzes and course evaluation questions relating to the pedagogies adopted in the course and resources provided undertaken in the last two weeks of the semester. In semester 2, clickers were used to provide feedback about the use of the technology during class sessions while in semesters 1 and 3 students responded verbally, but did not have the opportunity to respond to the same in class questions using technology. Both qualitative and quantitative methods are used to gather student opinion.

Results

Research Question 1

As other studies have shown (Liu et al., 2003; Ratto et al., 2003; Williams, 2003; Richards et al., 2006) students enjoy the interaction which education technologies such as a SRS can or may provide in the classroom. Student feedback on the use of clickers was extremely positive with 96% of students in semester 2 stating that they had enjoyed the opportunity to be better engaged. This was reinforced with qualitative comments such as:

'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'; and

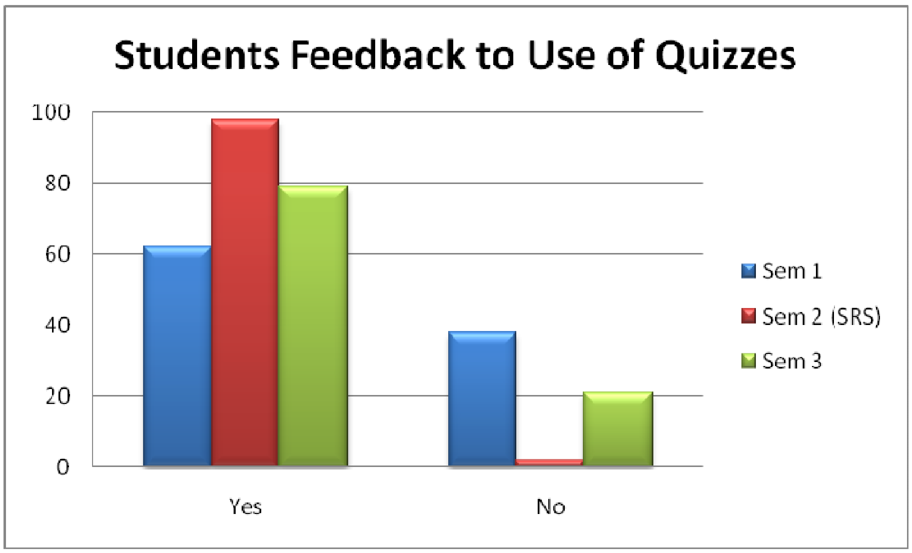
'Just want to say Thank you so much for your effort and help to make this course a very successful one. This is the best part of my studies so far. I've learned a lot on this subject and guaranteed that, i'm going to use this knowledge in the near future'.

Responses such as these and course evaluation surveys revealed a positive experience for most students involved in answer to research question one.

Research Question 2

In order to answer this question students were asked 'do you think that the use of quizzes in class helped you to understand the course materials presented?' Based on the feedback students provided about the effect the use of SRS technology and in class quizzes, there was a heightened perception with the second semester cohort about the usefulness of clickers via in-class quizzes to their understanding as indicated in Figure 4.

Figure 4:
Students feedback on use of quizzes with (Sem 2) and without (Sem 1 and Sem 3) SRS clickers



In answer to research question two responses indicate that students do perceive that the use of SRS education technology does significantly enhance the use of quizzes to gain an understanding of the material presented in classes. However students that did not have clickers available in the first (Sem 1) and third (Sem 3) semesters of the study still found the use of quiz questions during presentations useful so this pedagogical approach may contribute to their understanding, even if they are not able to respond to all questions verbally. This finding is supported by other studies (Draper and Brown 2004, Fitch 2004).

Research Question 3

Lecturers and tutors reported that students' responses to questions were more complete and willingly provided when clickers were used than without them. Instructors also indicated that they were able to more easily pinpoint areas that students did not fully understand. They indicated that assertive students did not dominate what was covered in reviews and did not dominate question time. Consequently it was felt by all teaching staff that clickers provide a pedagogy that allowed dynamic delivery and interaction between all class participants so that students' needs were more effectively met. This was supported by student comments made in survey and course evaluations:

'I enjoyed being able to participate in class. Kept me focussed especially during an accounting lecture';'

'I did not feel silly when my answer was not correct. Others got it wrong too….but the lecturer then explained why..that's good!'

Thus it was concluded, in answer to research question 3, that there is an increase in student participation in classes. The response to feedback from and by students displayed that they had enhanced their understanding.

Research Question 4

To answer research question 4, students' achievements on quiz questions delivered in-class and on other assessment items as well as final grades were compared to see if there was an association. Correlation analysis was undertaken to ascertain whether the use of clickers in class improved student performance as indicated in Table 1. However, no associations were found between students' collective results from in-class quiz questions and other assessment items or final grade in the course.

Table 1:
Correlation Analysis use of clickers and student performance in assessment items

ASSESSMENT ITEMS	*ASS 1*	*ASS 2*	*ASS 3*	*PARTICIP*	*EXAM*	*TOTAL %*	*Quizzes*
ASS 1	1.00000						
ASS 2	0.23320	1.00000					
ASS 3	0.34523	0.67940	1.00000				
PARTICIP	0.35391	0.42534	0.46184	1.00000			
EXAM	0.30123	0.59302	0.63756	0.25878	1.00000		
TOTAL %	0.41764	0.78501	0.85926	0.53779	0.90297	1.00000	
Quizzes	0.29445	0.49176	0.49710	0.57277	0.39477	0.56070	1.00000

What was identified was a decrease in the percentage of failures (and consequently an increase in passes) after the start of the Dynamic Education project in comparison to the semesters before the project commenced. SRS (clickers) was only one education technology introduced in Phase 2 (Sem 2) and although the trend in reduced failures continued from Phase 1 (Sem 1), it also was maintained in the last semester (Sem 3) of the study when clickers were not available. So the evidence here is not conclusive and further study is required.

As a summary of the findings in relation to the research questions, the study can conclude:

RQ1: Students do perceive that the use of a student response system (SRS) during lectures and tutorials provides a positive experience;

RQ2: Students perceive that the use of a student response system (SRS) during lectures and tutorials improves their understanding of course materials presented;

RQ3: The level of participation of students increases in lectures and tutorials when a student response system (SRS) is used;

RQ4: No statistically significant correlations were found between the performance in assessment between students that experience the use of

SRS and those that did not. However, in aggregate fewer students failed the course when a number of education technologies were adopted, including SRS.

Lessons and Limitations

A number of problems arise when attempting to introduce education technologies. Some of these problems stem from the lack of acceptance of educational technologies by academics. Teaching staff feel that technology intrudes on their traditional pedagogy of delivery and inhibits or hampers their teaching style. Consequently, one limitation of this study was that instructors teaching the same course on other campuses made very little use of the equipment provided, including clickers. More training will need to be provided for staff when planning future implementations of the technology.

Most students are comfortable with technology, but some mature-aged students are not. The clicker technology is simple for students to use and does not require a lot of training to use the devices effectively. However, it would be a different matter when students are at a distance and where they are using a variety of devices not all of which have the same procedure for submitting answers (if mobile phones, PDAs and pocket PCs were used as virtual clickers). This may become unmanageable for some academic staff if not well trained and without adequate procedures for students to follow.

The study reported has a number of limitations in terms of its design and conclusions reached. The number of students that participated is small and from one course in one discipline area. More demographic data would add richness to the interpretation of the results especially given the number of international students in our classes now. The SRS technology was used in one semester only and a longer time period is needed to fully evaluate the impact of SRSs on teaching and learning. Data collected from students on perceived benefit is also limited as the clicker technology was only one part of a larger project's data collection. Thus the conclusions must be read within these limitations and any conclusions are tentative.

Directions for future research

For future study, two major areas are being evaluated as part of Phase 3 of the Dynamic Education project. The first relates to the application of SRS technology with the types of response devices used and its application for students studying by distance education. The second will investigate further the reasons for the lack of acceptance of education technologies by academics. An evaluation of integrating SRS into a delivery method used during lectures will be undertaken. A set of questions to deliver content rather than just gain feedback on content delivered, would be an interesting pedagogical experiment. This may be more appropriate to quantitative material like accounting and mathematics than more qualitative course material. However, with a vPad-type response device, qualitative responses would be able to be captured. An issue identified earlier that would permit external students or students on different campuses to respond to questions, will also be investigated in Phase 3. Use of mobile phones, pocket PC and PDAs as well as tablet PCs will be evaluated to see if these technologies would reduce inequalities emanating from studying at a distance.

The intended virtual classroom will have the look, touch, feel and interaction as if the 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. 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 virtual environments that are more effective and student-centred.

Conclusion

This paper reports the outcomes of one stage (stage 2) of a much larger project – the Dynamic Education Project. Results indicate that there are some positive benefits to be gained through the use of SRS technology in accounting classes. Based on the analysis of students' feedback, both qualitative and quantitative, students viewed the use of SRS technology as a positive experience which improved their understanding of content by responding to the quiz questions presented. Higher participation levels and an enhanced learning experience occurred. While there was not a positive association between the use of the technology in class and assessment results, there was a reduction in failure rates for the cohort of students using the technology in semester 2. In addition, the two-way feedback provides instructors with a mechanism to dynamically change delivery of material to meet the needs and understanding of a particular cohort of students. The paper provides evidence to be used as a starting point for further research into the use of SRS technology in the educational process and an opportunity to expand the study to larger student groups and other disciplines.

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