Does Teaching with a Tablet PC Enhance the Teaching Experience and Provide Greater Flexibility?

What are the Students' Attitudes to Teaching with a Tablet PC?

Nadine Adams and Clinton Hayes

CQUniversity Australia

This project aimed to uncover both students' and lecturers' perceptions of the use of technology in the teaching of preparatory mathematics. We believe that the students' opinions of the delivery method of a subject can have a profound affect on their learning outcomes. As the lecturer/student interaction also has an affect on student learning outcomes, the researchers, as the lecturers of the courses, also participated in the study. This assisted in the understanding of students' perceptions.

No Literature was found that exactly matched our specifications. Though the literature does suggest a positive outcome for the majority of technology use in the class room, we cannot extrapolate from this the effect on adult learners in a preparatory mathematics class.

The study was conducted over a two semester period. During this time students were exposed to both traditional teaching methods, i.e. use of a whiteboard, and the use of a tablet PC and projector combination. The researchers aimed to ascertain if the use of technology in mathematics class has a positive effect on the students. At the conclusion of the second semester both students and lecturers were requested to complete a questionnaire.

The study suggested a direct correlation between the student perceiving the lecturer as being comfortable with the use of the technology and the student being favourably disposed to the use of technology. The researchers noted there were acceptance differences between the younger and the older students and those with and without prior computing experience. Overall the researchers found that the key to successfully integrating technology into the classroom was achieving a harmonious balance between the traditional and the technological that satisfied the needs all students and the lecturer.

Introduction

This project aimed to uncover both students and lecturers' perceptions of the use of technology in the teaching of preparatory mathematics. The increasing integration of technology based instruction into both schools and universities has been noted by many researchers including Hashemzadeh and Wilson (2007). Our division is no exception in embracing this phenomenon. As we embarked on this journey of change with regard to

teaching methods we felt it appropriate to give students a formal opportunity to express their opinions of different delivery methods. We understood that the method of delivery of a subject could have a profound effect on the students' learning outcomes. As the lecturer/student interaction also has an affect on student learning, the researchers, as the lecturers of the courses, also participated in the study. This aided the understanding of student perceptions. The researchers noted the absence of literature relating to students' opinions towards the use of technology in the classroom. This finding was supported by Moyle (2008)

Lecturers within the Mathematics Learning Centre at CQUniversity use Tablet PCs for a quantity of varied tasks – from teaching preparatory mathematics to answering student enquiries. This paper examines how the staff use their Tablet PCs and how this use enhances the teaching experience and provides greater flexibility.

Objectives

- Understand students' perceptions of the use of technology in the teaching of preparatory mathematics.
- Understand lecturers' perceptions of the use of technology in the teaching of preparatory mathematics.
- Determine if the skill or attitude of the lecturer in relation to the technology influences the students' perception.
- Determine how staff use Tablet PCs to enhance the teaching experience and provide greater flexibility.

Context-Background

The STEPS Program

The STEPS program began at the Capricornia Institute of Advanced Education (later to become CQUniversity Australia), Rockhampton, Queensland in 1986. The program, initially funded by a government grant, aimed at bridging the gap between tertiary education and underrepresented groups of people – which included Aborigines, migrants, women, and people from low socio-economic backgrounds and those from isolated areas (Doyle 2006). The first class contained 22 adults from these underrepresented groups.

Today the STEPS program is run on five individual CQUniversity Australia campuses in several different modes and also as an external program. The program has evolved to meet the changing needs of people who have not been able to attain their educational goals through traditional educational pathways. These students are often referred to as 'second chance learners'. Not only does the program equip students with academic knowledge required to commence an undergraduate degree but it appears to increase self-confidence.

The mathematics component of the STEPS program is Transition Mathematics 1. Transition Mathematics 1 is an elementary mathematics bridging course designed to cover the basic concepts of mathematics. It provides a mathematical foundation for students to further build upon should the need arise. Students wishing to enter mathematics based undergraduate

degrees, such as engineering, are advised to complete further preparatory courses in mathematics.

The Mathematics Learning Centre

The Mathematics Learning Centre (MLC) at CQUniversity was established in 1984 as an academic support centre. The MLC staff provide mathematics assistance to students from a broad range of disciplines as well as teaching into the STEPS programme, running several preparatory programs and creating mathematical resources. Tablet PCs are used, by MLC staff, in a variety of ways to provide these services.

Evolution of the Tablet PC

The tablet PC is basically a laptop computer with increased functionality. The tablet enables the user, through pen technology, to use the computer to 'scribble'. Pen technology has been around for at least two decades but its beginnings were very tumultuous. There was much excitement surrounding the technology in the late 1980s, reaching a peak by 1991 (Blickenstorfer 2005). It was envisaged that this technology would eventually replace the mouse and keyboard but these pen computers were difficult to use and the handwriting recognition was inadequate (Blickenstorfer 2005). The initial hype was followed by a steep decline in popularity such that by 1995 the technology was almost extinguished in the consumer market (Blickenstorfer 2005). In 2002 Microsoft re-introduced the pen computer as the "Tablet PC" thus revitalising the technology (Blickenstorfer 2005).

Improved computer technology makes the newer versions of the tablet more successful than the earlier versions. Computers are now lighter and more efficient, hardware is more affordable, processors are faster, resolution is finer and handwriting recognition software has been vastly improved (Jones n.d). The new tablet PC does not attempt to replace the mouse and keyboard but complement them and although handwriting recognition is still a feature, "digital ink" is the predominant feature (Blickenstorfer 2005). "Digital inking" allows the user to write on the computer using a pen. No attempt is made by the computer to convert the writing into text as is the case with handwriting recognition software.

The Rise of Technology in the Classroom

Although the education sector has had a long relationship with machines in learning and teaching, their use was not supported until the mid 1980s (Godfrey 2005). By the commencement of the new millennium schools were experiencing a shift in the focus of learning from outcomes centred - where student outcomes are specifically aligned with instructional methods and assessment - to the quality of experience (Godfrey, 2005). In 2001, the Organisation for Economic Co-operation and Development (OECD) identified three main reasons why schools should adopt Information and Communication Technologies (ICT) within schools. The reasons were economical, social, and pedagogical. The rationales for each were:

- Economical - an important aspect of employment was knowledge of and familiarity with ICT and nations successfully embracing technological advancement would benefit economically;
- Socially - ICT competency was viewed as an essential "life-skill"; and

- Pedagogical - ICT could increase the depth and richness of learning and could support the development of higher-order thinking skills.

The computers of today's classrooms have evolved from instructional machines to powerful teaching and learning tools capable of a high level of interactivity that can empower the educator and improve the teaching and learning process (Godfrey 2005).

The STEPS Difference

In Schools the majority of students are comfortable with Information and Communication Technologies. It is highly likely that many students are more comfortable with the technology than their instructors. This is not the case with STEPS students, many of whom have had limited computer exposure

We therefore felt it is necessary to give these students an opportunity to express their opinions with regard to delivery methods. We also wanted to know how lecturers respond to the use this technology within their teaching and believed that the lecturers' confidence or apparent confidence with the technology affected the students' perception of the technology.

Literature Review

The literature reviewed predominately pertained to young people. It is therefore difficult to glean from the available literature the effects of technology on adult learners. It is evident, though, that technology in the classroom is on the increase and successful implementation requires a greater understanding of both the advantages and disadvantages and also appropriate use. There were varying opinions amongst researchers but the overwhelming messages gained from the review were to avoid the overuse of technology, ensure its use improves learning outcomes and that it is implemented effectively.

Technology in the Classroom

The Department of Education and Training estimated that in New South Wales in 2007 the ratio of students to computer in schools was approximately 6:1 (Achterstraat 2007). This is an increase from 1995 of twenty students per computer and 1999 of eleven students per computer (Auditor-General 2000). It is clear that the trend of computers in schools is on the increase. As part of Federal Labor's Education Revolution, Prime Minister Kevin Rudd, promised one computer for every student in years 9-12 (Archer 2007). Australia is not the only country placing enormous importance on the increased use of technology in schools.

The United States of America appears to be placing escalating significance on technology education as part of the overall learning experience as evidenced by the number of states including technology education in the state framework (Dugger 2007).

Ozel, Yetkiner and Capraro (2008) believes that the integration of technology in the mathematics classroom is important to the field of education due to society's increasing reliance upon technology, its technological advancement and schools embracing technology as a fundamental element of the curricula. Technologies presently being utilised in mathematics classes include but are not limited to: calculators, interactive whiteboards, computers, immediate response devices (electronic devices that quickly record audience member responses to questions during meeting, training, and survey activities), overhead

projectors and web based applications. Effective integration of technology into mathematics classes can have many positive effects, including improved attitude and increased engagement with mathematics, but these positive effects are dependent on how well the technology is used (Ozel, Yetkiner & Capraro 2008). Chester (2008) believes that the enjoyment and effectiveness of the tablet PC by both the instructor and the student can be enhanced by an awareness of the availability of additional software.

Attitude of the Instructor

In a discussion of the use of PowerPoint® as an educational tool, Brown (2007) concludes that the user has more influence in the learning process than the computer programme. The basis of her argument is that PowerPoint® is simply a communication tool and that the use of that tool lies with the user. Brown's argument is supported by Klemm (2007) who believes that instructors can be trapped into less than desirable teaching practices by the over use of PowerPoint® or other slideshow software. Klemm (2007) identifies four problems associated with slideshow software as it is usually used:

- students can slip into "entertain me" mode,
- interaction with the delivered content is not required,
- reduced interaction between the instructor and the students and finally
- the problems are exacerbated by the use of handouts.

Both Brown (2007) and Klemm (2007) agree that this software, if better utilised, could be a powerful tool. Brown (2007) encourages users to gain an indepth knowledge of the programme and its abilities and to use it creatively. Klemm suggest that the content on slides should not be shown in 'show' format and the number shown at any one time should be limited to encourage interaction. Klemm (2007) asserts, "Full interaction with the content will not occur unless the teacher inserts questions, problems, and tasks into the slide show".

We have used PowerPoint® for the basis of our teaching using the tablet PC. In our investigation the PowerPoint® presentation was not merely clicked through and spoken to. The PowerPoint® was loaded into Notepad®, which enables the instructor to write on the slides. This creates an element of whiteboard style teaching where the instructor talks the class through a problem while writing it on the board. Now we tend toward the use of PDFs and PDF Annotator, instead of PowerPoint®.

Attitude of the Student

In 2008 Moyle noted that the literature revealed very little Australian research investigating learning with technologies by listening to students' voices had been published in the previous six years.

Ku et al. (2004) examined the effects of personalising computer-based instruction for individual students and how this effected their achievement and attitudes in the study of mathematical computational problems and word problems. This study focused on middle school American students. Results from this study showed that there was a positive effect on both achievement and attitude though the positive effect on achievement was only significant amongst children entering with low-level mathematics knowledge.

A positive attitude toward the use of Tablet PCs amongst hearing impaired students was uncovered in a study by Liu et al. (2006). This study found that the use of the tablet PC and

associated scaffolding improved communication between lecturer and student and enabled the student to more readily participate in learning activities. “Students stated that the environment with wireless technology was desirable and said that they hoped to continue using the environment to learn mathematics” (Liu 2006 p.345). In this environment, the teacher lectures on a shared whiteboard using a stylus to write on their tablet and projecting this on to a large screen. The students use their own tablets to place responses and questions on the shared whiteboard. Students can ask private questions of the teacher through the wireless network. This setup removes the need for a teacher with signing skills.

Boon, Fore and Rasheed (2007) examined students’ attitudes and perceptions toward technology-based instruction and found that the majority of students participating in their study also had a positive attitude toward the use of computers as a teaching aid. It was noted that there was increased satisfaction amongst students with disabilities.

Contrary to these findings, D’Angelo and Woosley (2007), in a study of undergraduate students, found that students did not always find technology beneficial to their learning. “Overall students seem to have mixed reactions to technology” (D’Angelo & Woosley 2007 p. 462). When contemplating the use of technology in the classroom, instructors should consider their reasons for its use and how it will be used and then explain these to the students as students are more accepting of different teaching styles if they comprehend the rationale behind them (D’Angelo & Woosley 2007).

Use of Technology in the classroom

Niess (2005) noted that even though pre-service teachers may have been taught their subject matter through the use of technology, this was not the same as learning to teach with technology and that only a small number of teachers feel comfortable incorporating technology into their teaching. Technology-enhanced pedagogical content knowledge (TPCK) is the integration of knowledge of teaching and learning; development of subject matter knowledge and technology. This study examined the TPCK of student teachers enrolled in a preparation program integrating teaching and learning with technology throughout the program.

> Emergence into the 21st century features tools that are different, communication that is different, and work that is different. Given this shift, education must shift to incorporate computer-based, electronic technologies integrating learning with these technologies within the context of the academic subject areas (Niess 2005, p. 509).

This is supported by D’Angelo and Woosley (2007), who suggest that educational technology is a part of the instructional experience and that students may not be able to avoid it.

Liu et al. (2006) used Tablet PC in combination with wireless technology in the classroom to aid ‘hard of hearing students’ in a Taiwan junior high school. The purpose of the study was to explore whether wireless technology, including wireless network and Tablet PCs, could enhance student-teacher interaction, reduce cognition load, and facilitate formative assessment (Liu et al. 2006 p.346). A specialist platform was required to enable the children to either communicate directly with the teacher or make the comments available for class viewing. Results demonstrated increased student participation in learning activities and fewer mistakes in in-class course work.

In a study of the effect of using computers to teach African-American algebra students how to solve linear equations, Walker and Senger (2007) found no significant difference in achievement between the computer group and the non-computer group.

Ysseldyke and Bolt (2007) examined whether maths results could be enhanced through the use of technology-enhanced continuous progress monitoring.

> Technology-enhanced continuous progress monitoring provide teachers with the data they need to differentiate instruction, group students on the basis of comparable goals, and mange or adapt instruction based on student performance (Ysseldyke & Bolt 2007 p. 453).

Using this process, teachers alter their instructions based on students' results. It was found that students in the trial group significantly outperformed the control group.

Methodology

Over a two-semester period students were exposed to both traditional teaching methods and the use of a tablet PC. The students retained the same lecturer for both semesters. This required the lecturers to adjust their teaching methods to accommodate that required for the semester of the study. It was felt that it would be disruptive to the students to change lecturers as well as teaching methods. This had what we now perceive as, the added benefit of exposing one group of students to an instructor less experienced in the use of the technology.

The researchers explored whether the use of technology in mathematics class has a positive effect on the students and also if the experience of the operator affected the students perception of the technology. At the conclusion of the second semester both the students and the lecturers were requested to complete a questionnaire. The questionnaires consisted of open-ended questions. This method of questionnaire was adopted to avoid 'baiting' or limiting the responses through multiple-choice answers.

Discussion

The researchers were surprised to find a one-to-one correlation between the operator's perceived confidence with the technology and the students acceptance or rejection of the technology as a teaching aid. That is, there were exactly the same number of responses that thought their lecturer was confident with the technology as there were those that viewed the technology favourably; there were also exactly the same number that thought the lecturer was not confident as there were those that viewed the technology unfavourably.

Even though the majority of students conveyed a favourable disposition toward the use of the Tablet PC in STEPS mathematics classes, many of those students did not feel that it enhanced their learning experience. A few of the students found the use of the Tablet PC enhanced their learning through the enhancement of visual stimulation thus providing improved concentration, interest and stimulation for visual learners. The majority of the students that felt that the Tablet PC did not enhance their learning experience commented that they were 'used to the whiteboard'. We had noted, while we were teaching, that there was a resistance to change among the older students, though this is not substantiated by the

research. Other students who did not feel that the Tablet enhanced their learning experience expressed dissatisfaction with the size of the projection and the reliability of the technology. They also reiterated the lecturer's appearance of discomfort with the technology and felt the technology made the teaching feel impersonal.

Of the Twenty-six students surveyed only seven believed that the Tablet PC was without benefits and/or appeal. The students generally could identify some benefit or attribute of the Tablet PC in the teaching of STEPS mathematics even if it was not their chosen teaching method. When asked if they preferred the tablet or the whiteboard method of teaching, three students preferred the tablet, 13 the whiteboard and nine preferred the whiteboard/tablet combination.

Both lecturers had received training in the use of the tablet PC. This included setting up the equipment, opening the software and importing the teaching PowerPoints into Windows Journal. The pen-technology then allowed the PowerPoints to be written on. The textbook and other teaching aids could also be imported, displayed and annotated. Despite the training one of the lecturers felt less than confident with the technology. This lecturer believed that age was a contributing factor to this technophobic disposition.

The researchers found that using the whiteboard and the tablet in combination lead to enhanced teaching methods and greater flexibility than being limited to one method. One example of this is in demonstrating worded problems. Rather than rewriting the problem on the whiteboard or requesting the student to follow in their textbooks, the problem could be projected onto the whiteboard and the key points highlighted using the pen-technology and the problem could then be worked on the whiteboard beside this. This was just one of the ways that the Tablet PC could enhance the teaching process without dominating it.

The researchers believe the key to successfully integrating technology into the classroom is achieving a harmonious balance between the traditional and the technological that attempts to satisfy the needs of all students and the lecturer.

Using the Tablet PC outside of the classroom

As well as using tablet PCs for teaching, Mathematics Learning Centre staff use their tablet PCs for assisting external students who cannot get to a campus for assistance. The enquiries arrive via telephone or e-mail. Before we had tablet PCs, if a student rang in for assistance we would talk them through the problem and hope that they had written down what was said correctly. If the enquiry came via e-mail the tutor would attempt to type the solution and an explanation. Now with the tablet PC, regardless of the method of enquiry, the tutor can write the solution and add annotations in different colours. We have found that converting this to a PDF document makes it more universally acceptable and removes the possibility of the student not being able to open or view the document. This can then be attached to an e-mail and sent to the student. All solutions can be saved and used again for future students as required.

If the enquiry contains a problem that is involved and would require excessive annotations, the tutor can make a video using Camtasia® or similar software. This can then be sent to the

student via e-mail. As long as the videos are kept short and the file size small, students find these to be a valuable learning tool. These too, may be kept and reuse as required. Each video can be tailored to the individual student whilst still allowing the reuse of previously prepared material.

Staff have discussed the advantages of using tablets for on-campus MLC students. As many of the students require assistance with a problem previously explained to another student, we find ourselves rewriting the same equation and explanation repeatedly. If we used the tablet PC, which is remotely connected to the printer through a wireless network, we could print subsequent enquiries.

Mathematics Learning Centre staff also use their tablet PCs for marking external preparatory course assessment. This enables them to greatly decrease the time taken for students to receive their results and feedback.

Conclusion

The study conducted demonstrated the effect that the perceived confidence of the operator of technology can have on the enjoyment of the student. The same can be said for the operator – if they do not feel confident they will not enjoy using the technology. This point highlights the need for adequate training. Students and lecturers were most satisfied with the use of technology in the classroom when it was combined with traditional methods. This allowed greater flexibility in teaching methods and styles.

As an instructional tool outside the classroom the tablet PC has become invaluable to Mathematics Learning Centre staff. It has been used to provide assistance to off-campus students through the ability to provide handwritten solutions in 'digital ink' and create small personalised instructional videos.

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