Full Paper

Introduction

Increasingly at the School of Engineering (CQUniversity), the use of paper has been replaced with the use of word processing software and submission of assessment is undertaken digitally through a learning management systems (LMS). Whole courses are now run electronically, this includes; student assessment submissions, marking of and returning of assessment, all course materials and video resources. The dominance of the flexible mode of study at CQUniversity requires the development of courses that can be delivered through a LMS. School of Engineering at CQUniversity is not alone in this regard.

A Tablet PC is a laptop computer that is equipped with a touch screen and stylus (pen) enabling the user to annotate (write on) the screen. Current use in courses show that as well as positively influencing the students' attitudes towards mathematics and their work habits it also affords students an understanding of the relevancy of course content in terms of the course learning outcomes.

What is a Tablet PC/Wacom Screen?

The Tablet PC is essentially a laptop computer that enables the user, through pen technology, to annotate (write) on the screen. Wacom Screen is similar to a Tabletpc but needs to be connected to PC or MAC. There was much excitement surrounding the technology in the late 1980s, reaching a peak by 1991 (Jones, 2008). It was envisaged that this technology would eventually replace the mouse and keyboard, but they were difficult to use and the handwriting recognition was inadequate (Jones, 2008). Fortunately, improved computer technology has resulted in greater functionality with the newer versions. Tablet PCs are now lighter, more efficient and more affordable; processors are faster; resolution is finer; and the handwriting recognition software has been vastly improved (Blickenstorfer, 2008). Additionally, no attempt has been made to replace the mouse and keyboard in the current Tablet PCs and although handwriting recognition is still a feature, "digital inking" (allowing the user to annotate on the computer using a stylus or pen) proves to be its strength.
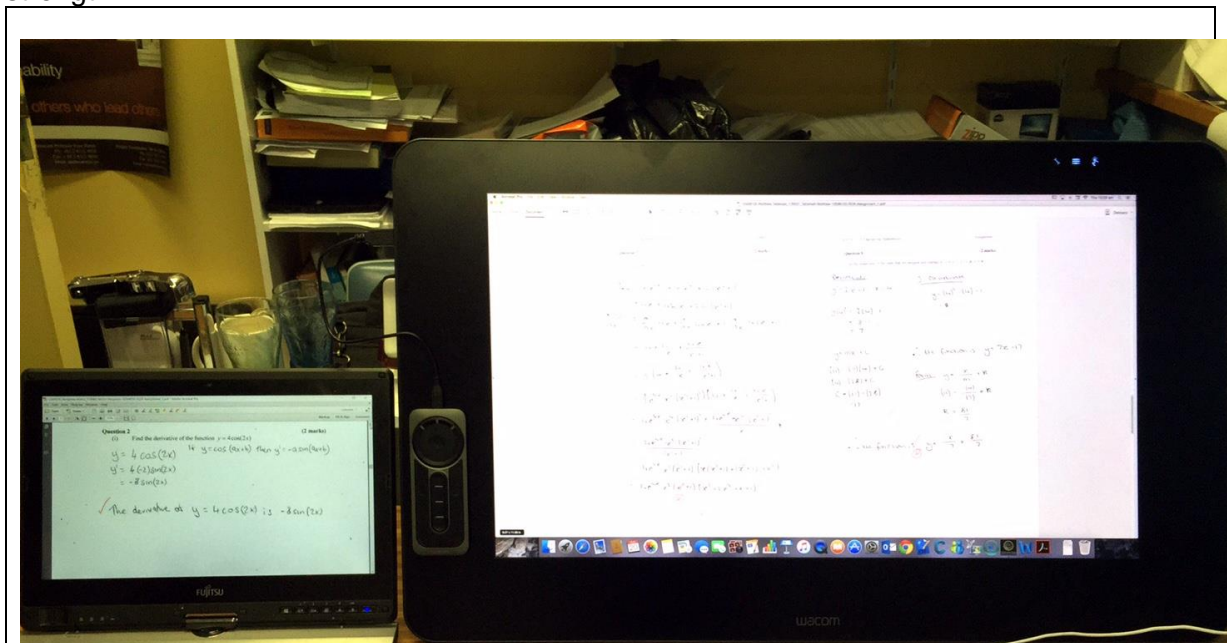

Figure 1: Tablet PCs and Wacom Screens

Tablet PC in the tertiary classroom context

The Tablet PC is both an innovative and adaptive form of technology which is able to support the teaching and learning process. The potential of this tool is evident and significant in terms of its application within the learning context. TabletPC technology has been available in Australia since 2002 . Given this time period, it is not a new innovation in the tertiary classroom context.

From the wider literature, it is evident that the predominant research on the use of TabletPC's in tertiary institutions, has been conducted, almost exclusively on benefits to students and to the exclusion of staff benefits. While some research has been conducted on inhibitors and motivators of effective use of tablets by Academics within the higher education system, such as the 2010 Carrick project "Building Leadership Capacity for the Development and Sharing of Mathematics Learning Resources across Disciplines Across Universities" (Porter, 2010), this project did not develop a systemic approach for a coordinated, cohesive and inclusive framework for supporting staff in the use of Tablet PCs in tertiary institutions.

Much of the Literature involving Tablet PCs discusses the advantages, disadvantages or implementation of the tablet PC as a teaching aid. We were unable to locate literature that discussed the benefits of the tablet PC as an administrative aid. Though there were those that highlighted the benefits of the tablet PC for marking.

The Tablet PC has a beneficial use in education both inside and outside of the classroom (French, 2007). When marking assignments, French (2007) explains how the Tablet PC can be used by the instructor to ink and save Word documents which can then be viewed on any Course Management System by the student. The Tablet PC enables teachers to send students an electronic copy of feedback which contains hand written annotations (Neal & Davidson, 2008). Another benefit of 'e-marking' as seen by Chester (2008) is the reduction in the amount of paper required to be handled when evaluating students.

It is well accepted that distance study is increasing in higher education. Formative assessment and prompt quality feedback are seen as the key to student engagement and success when studying by distance. Feedback given as part of assessment assists students to bridge the gaps between their present knowledge and required knowledge. "The importance of feedback provided through assessment is not only an important part of the learning process but is also reciprocal" (Dekkers, Adams & Elliott, 2011). Although the focus is usually on the benefits for students, many forget the valuable information gained by the marker, especially in regard to any concepts that may be commonly misunderstood. Additionally, the quality of feedback received is crucial in improving learning (Sadle, 1998). The Wacom screen enables teachers to send students an electronic copy of feedback which contains hand-written annotations (Neal & Davidson, 2008) enabling prompt quality feedback. Another benefit of 'e-marking' as seen by Chester (2008) is the reduction in the amount of paper required to be handled when evaluating students. In fact some courses at CQUniversity are completely paperless. Through the incorporation of the Learning Management System (LMS), the Tablet PC/Wacom screen and formative feedback, CQUniversity can engage and efficiently support students thereby improving student retention (Dekkers, Prue, Adams & Martin, 2013).

Some scholars such as Hume (2011) find that the writing surface of the Tablet PC produces poor quality writing and has the effect of making bad writing worse. Reseach by Adams and Hayes(2012) confirmed that it is not the quality of the writing that is important to students but the quality of the feedback that is provided. We use our formative assessment as a teaching tool. Mistakes are highlighted and the problem is reworked correctly demonstrating correct working and setting out. Extra annotations are added as required to aid the students understanding.

CQUniversity Bachelor of Engineering Teaching Context

The CQUniversity Bachelor of Engineering (Co-op)/Diploma of Professional Practice (Engineering) is a 4.5 year full time undergraduate degree and is offered in both off and on campus modes. The four and one half years includes a minimum of 48 weeks of work placement in the student's relevant discipline. CQUniversity engineering work integrated learning program incorporates Project Based Learning, Co-operative Education with Professional Practice, providing learning in context, both in formal and informal learning environments (e.g. in workshops and classes and project studios) and in employment in industry, integrated in your study program. Teamwork and problem solving skills are learned alongside the technical content in an exciting real-world engineering environment CQUniversity Bachelor of Engineering is offered in campus from the Cairns(starting 2015), Mackay, Rockhampton, Gladstone and Bundaberg campuses(CQUniversity Handbook 2015). In 2015 there was approximately 600 students enrolled in the Bachelor of Engineering at CQUniversity.

Within School of Engineering and Technology at CQUniversity there are a number of possible combinations of teaching/learning methods. Table 1 summaries this information in terms of teaching/learning method and type of media.

Table 1: Teaching/Learning Method and Type of Student

Teaching/Learning Method	Traditional on campus Student	Traditional off campus Student	Computer meditated Learning / Internet Student
Face to Face Lectures	✓		
Face to Face Tutorial	✓		
Independent Study	✓	✓	✓
Seminar	✓		✓
Video Conferencing Lectures/Tutorial/Workshops	✓	✓	✓
Audio Conferencing Lectures	✓	✓	
LMS	✓	✓	✓
E-mail	✓	✓	✓
Boggs	✓	✓	✓
Mailing lists	✓	✓	✓
Print materials	✓	✓	
Audio/Video		✓	✓
DCD/CD	✓	✓	✓
Telephone		✓	
Study Group	✓	✓	✓
Feedback	✓	✓	✓

Within the Engineering Program at CQUniversity, the use of paper has been replaced with the use of word processing software and submission of assessment is undertaken digitally

through a LMS (moodle). Whole courses are now run electronically, this includes; student assessment submissions, marking of and returning of assessment, all course materials and video resources.   All of this greatly reduces the archiving required for engineering accreditation purposes as all of this information is now available in a compressed file at the end of the term.

Tablet PC's have the potential to play a large role in the paperless course. They can be used to mark and send feedback to students electronically through the LMS system(Moodle at CQUniversity). They can also be used to create and record lecture notes. Without a Tablet marking and providing electronic feedback on the students own assignment requires initially printing and then marking students work, scanning this work, creating a document and sending the document to students. Use of the tablets has the potential to remove all of the extraneous work from this process.

Table 2: Comparison of currently computer used by staff School of Engineering and Technology at CQUniversity.

Topic area	Notebook	TabletPC	Wacom Screen
Description	10 to 15 inch screen	10 to 15 inch screen	24 to 27 inch screen
Hand written Annotations/ Marking	Cannot annotate and view about third of a A4 page.	Can annotate and view about third of a A4 page.	Can annotate and view 2 A4 pages or 1 A3.
Portable	Yes	Yes	No, Notebook or PC needed.
Pre-prepared material	Material can be pre-prepared using Word/PowerPoint presentations can be reused.	Material can be pre-prepared using Word/PowerPoint presentations can be reused.	Material can be pre-prepared using Word/PowerPoint presentations can be reused.
Write on Pre-prepared material	No	Yes, using the Tablet PC pen for writing and highlighting.	Yes, using the Tablet PC pen for writing and highlighting.
Make material available before and after the lecture	Yes	Yes, comments added to materials in class can also be given to students.	Yes, Wacom screen is not portable
Videos and pictures	Yes. Useful for off campus students	Yes. Useful for off campus students	Yes. Useful for off campus students
Cost	$1500 to $5000 Additional monitor $600 (27 inch)	$2000 to $5000 Additional monitor $600 (27 inch)	$3000 to $4000 Notebook or PC needed $1000 to $5000

Using a TabletPC for the classroom or lecture hall is becoming more and more common. (Anderson, John, Schwager, Paul & Kerns, Richard, 2006, Mock, Kenrick, 2004, Willis, Cheryl, & Miertschin 2004). The CQUniversity campuses are connected together using Video Conferencing and students and staff can see each other on other campus. The Tablet PC can be connected to a data projector and fulfil the functions of both whiteboard and overhead projector without the disadvantages of either. Unlike a whiteboard, all classroom board work can be recorded digitally and be made available to students in a suitable electronic file format. Students can then replay lessons, exercises and activities at a later time. Similar to the overhead projector, a Tablet PC can be used to expand, amend, or highlight prepared learning materials, and given its portability, it is an extremely useful and interactive teaching tool.

The type and format of the assessment determines suitability of assessment tasks for marking with the Tablet PC. The type of response or feedback required for the assessment piece will indicate whether the Tablet PC will be adopted. For example, some types of assessment required a standard response type feedback such as "an abstract is a summary of the report rather than an introduction". This type of feedback can be given from a standard response bank. While the Tablet PC can easily allow the use of standard hand written responses, not all users are aware of or familiar with this function. The selection of a tablet is dependent upon its application and the file format the student is required to submit. It is imperative that the tablet supports the required software.

Through the incorporation of the Learning Management System (LMS), Tablet PCs as well as formative and diagnostic feedback, academic staff can engage and efficiently support distance students in a way that has not previously been possible. As an instructional tool outside the classroom the tablet PC has become invaluable to staff (Dekkers, Prue, Adams & Martin, 2014). 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.

The Program leader of the engineering programs at CQUniversity has observed varying degrees of reticence in engineering staff for using the Tablet PCs as an integral tool in the teaching learning process. Research (D'Angelo and Woosley, 2007) shows that there are many factors that contribute to this current impasse which influences on teaching staff use of Tablet PCs. Significantly individual confidence, skill level, suitability of assessment tasks and technological compatibility are some of the significant determinants in Engineering Staff embracing the use of Tablet PCs (Adam & Hayes 2011).

User confidence is also a significant consideration. Niess (2006) found that both student and lecturer comfort with the use of tablets in class relied on the confidence of the user. Staff require adequate training prior to any request to incorporate the technology into their teaching practices. Staff are usually more inclined to use a tablet that is available solely for their use rather than one that is available through a loan bank (Dekkers, Howard, Adams & Martin 2014). Adams & Hayes(2011) 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.

Also Adams and Hayes (2012) 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. Adams and Hayes (2012) demonstrated the effect that the perceived confidence of the teaching staff of technology can have on the enjoyment of the student. If teaching staff do not feel confident they will not enjoy using the technology. This point highlights the need for adequate training. Students and teaching staff were most satisfied with the use of technology in the classroom when it was combined with traditional methods.

As the Bachelor of Engineering at CQUniversity is delivered on 5 campuses and in distance mode the major advantages using a Tabletpc/Wacom Screen include:

- Is the speed in which students receive their marks and valuable feedback as to a process is paperless.
- Videos enable the student to hear and see the content unfold, providing instruction similar to that given in a class situation. Videos are available from the course Moodle site;
- In Video Conferencing Lectures lecturer not only explains the concepts and ideas but also the mental processes involved in problem solving;
- Reduction in the number of assessments that go astray in the post as most assessment is submitted through Moodle;
- Electronic copies of assessments and grades are readily available to staff regardless of location;
- Electronic copies can be viewed instantaneously by the lecturer if the student requires further feedback;
- Ability to provide personalised feedback in a timely manner;
- Reduction in moderation time;
- Permanent copies remain available for archiving and accreditation purposes.

Conclusion

Given the current national agenda to improve the learning outcomes of engineering students graduating from tertiary institutions (King, 2008), examination of the ways in which the TabletPC has been used by engineering lecturers, provides an area of potential scope and benefit to universities. The Tablet PC assists with the provision of extensive resources, such as instructional videos, that actively engage students. Following the Seven Principles for Good Practice in Undergraduate Education (Chickering, 1987) the resources engage students in the learning process, regardless of their mode of study. Discouraging passive observation, through the embedding of activities into video instruction and associated discussion forums, facilitate student engagement with both the course content and other students.

The TabletPC also provides lecturers with the capability to provide comprehensive and informative feedback in a timely manner. Assessment provided promptly, positively influences the students' attitudes towards mathematics and their work habits and affords them an understanding of the relevancy and application within the Engineering program.

Now that many courses have the video support, and LMS submission is required, the study is being repeated. As part of the new study, students are requested to rate resources based on their level of usefulness as well as indicate the ease of submission and resource location. Further changes to be incorporated include on-line quizzes with video support that will enable students to obtain instant feedback on assessment.

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