Strategies to Remove Barriers and Increase Motivation to Use the Tablet PC in Formative Assessment.

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BACKGROUND
The Tablet PC has been employed to provide feedback through formative assessment to students in preparatory mathematics courses at Central Queensland University for close to a decade. A study conducted in 2011 on formative assessment and feedback given via the Tablet PC within these courses conveyed extremely positive outcomes (Adams, Dekkers and Elliott, 2012). Approximately 90% of the 140 students surveyed found the feedback beneficial to their learning and that assessment was returned, on average, within two to four days . These findings would indicate that these methods should be adopted into mainstream higher education courses (Adams, Dekkers and Elliott, 2012).

PURPOSE
This paper investigates how engineering academics can be encouraged to integrate the use of the Tablet PC to improve student understanding of course content through formative assessment feedback. In particular it looks at the barriers and motivators for using the Tablet PC.

DESIGN/METHOD
Building on the research and experiences of staff involved in the use of the Tablet PC to provide feedback on formative assessment in preparatory mathematics courses, strategies are to be developed to implement and improve these practices in undergraduate engineering courses. Using a grounded theory methodology, the research team have a two stage process. Stage one which is reported on in this paper uses the observations of the team to identify the barriers and motivators.

RESULTS
Based on the results obtained from studies conducted on the utilisation of Tablet PCs in preparatory mathematics courses, incorporation of the technology into engineering undergraduate courses would appear to benefit students. Stage one identifies the motivators and barriers and how these impact the uptake of the Tablet PC within the engineering school of Central Queensland University.

CONCLUSIONS
The Tablet PC is both an innovative and adaptive form of technology which is able to support the teaching and learning process. Through the recognition of the observed positives and negatives of Tablet PC application in other courses strategies will be implemented that remove the recognised barriers and provide benefits thus encouraging engineering academics to use the Tablet PC to provide feedback on formative assessment.

KEYWORDS
barriers, motivators, tablet, tablet PC, formative assessment, staff engagement.

Introduction

It is well accepted that distance study is increasing in higher education. In fact Harry (2003) notes that in many countries over the past thirty years, distance study has moved into the mainstream of higher education. Formative assessment and prompt quality feedback are seen as the key to student engagement and success when studying by distance. “The importance of feedback provided through formative assessment is not only an important part of the learning process but is also reciprocal” (Dekkers, Adams & Elliott, 2011). Through the submission of the assessment, the student provides feedback to the lecturer, who in turn provides feedback to the student through marking and annotation.

The incorporation of the Learning Management System (LMS), the Tablet PC and formative assessment feedback, enables lecturers to engage and efficiently support students, thereby improving student retention. Investigating how the Tablet PC has been employed to provide feedback through formative assessment to students in preparatory mathematics courses provides a basis for the Tablet PC to be incorporated into engineering courses. How to encourage academics to utilise the integrative use of the Tablet PC and formative assessment to improve the understanding of course content, thus fostering improvement to formative assessment feedback, which has been proven lead to increased student retention, remains an unanswered question.

This paper will explore the relationship between the Tablet PC and formative assessment and examine a range of teaching and learning strategies for the effective use of Tablet PCs appropriate for students’ study demands and application of the tool within engineering courses. In particular, meaningful teaching/learning contexts in which lecturers are able to effectively utilise Tablet PCs, engaging in a range of activities appropriate to the learning styles of the students and provide formative assessment feedback. The adoption of the Tablet PC, for marking, in combination with learning management systems will further facilitate a smooth transition to a paperless course environment. Optimally, the benefits obtained by integration of the Tablet PC in course delivery will be adopted by the wider university community.

Technology and Higher Education

There has been increasing use of information communication technologies (ICTs) in all aspects of society. The rapid rate of technological change has resulted in universities using the online learning environment as a means of course delivery (Fleming, 2010). “Improving the quality of learning is no light undertaking and does not happen just because teaching goes online. A high quality learning system with real potential for improving student performance would entail a quite substantial investment—human, intellectual, financial…” (Skilbeck, 2001, p. 62).Subsequently there is a need for lecturers to provide the interface between the “educational technology” of the learning and teaching environment and the “technological literacy” demands of society. “Things (most commonly tools) are therefore rendered useful to humankind, within the framework of fitting tool to purpose” (Millwater, 1988, p3).

Individual impressions are shaped by the nature and form of the technologies used to encode and decode experience. “The medium is the message” (McLuhan, p2). The technology conveys the critical and dominant information through its role in influencing the views, ideas and attitudes of the user. This principle is significant in the development of programs which need to consider both the affective and cognitive domain of students’ learning. A multi-sensory approach would provide a variety of mediums appropriate to a range of learning styles and allow students the opportunity to interact with the technology at their own level. This approach would involve providing a range of age old media and also the defining technologies of our times in order to foster and perhaps enhance the ways of thinking generated.

Effective integration of technology into classes can have many positive effects, including improved attitude and increased engagement with content, but these positive effects are dependent on how well the technology is used (Ozel, Yetkiner & Capraro, 2008). According to MacKeogh and Fox (2009, p. 147) “one vision of the future of universities is that virtualisation and remote working technologies will enable us to study at any university in the world, from home”. As universities are pressured to implement eLearning technologies into mainstream higher education, the Tablet PC provides the opportunity to achieve this.

Tablet PC

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. The first author introduced the Tablet PC into his classroom in 2003. This early instruction included using the Tablet PC in combination with Windows Journal® to annotate Microsoft PowerPoint® slides, very similar to how other staff use the Tablet PC in class today. He also experimented with the use of the Tablet PC for marking and the creation of teaching videos. In 2006 the first external offering of Skills for Tertiary Education Preparatory Studies (STEPS) at Central Queensland University commenced. This programme proved to be pivotal in how Tablet PCs were used to support students.

The first external class relied on paper based marking of formative tests to provide students with feedback on their progression in the course. A significant issue arising from this was the lengthy turnaround time for returning marked tests to students. Given that the first and third authors, the two lecturers responsible for this initial external offering, were on campuses 400km apart, the problem was exacerbated. To eliminate this problem and to overcome the isolation associated with external study and to provide students with prompt step-by-step instructions, electronic marking was implemented and student assessments were saved to a shared drive allowing the lecturers fast easy access regardless of their geographical location.

In a discussion on computer based assessment (CBA) Siozos, Palaigeorgiou, Triantafyllakos, & Despotakis, (2009) note that feedback is an important element of the learning process and regardless of the sophistication of the feedback system, CBA is unable to replace teachers’ comprehensive ability to provide personalised feedback. The Tablet PC enables the benefits of both CBA and personalised feedback to be combined. The potency of this combination is increased when it is amalgamated with formative assessment.

Formative Assessment

Davis & McGowen (2006) found formative assessment was the key to student success in mathematics. Hattie (2009, p.238) insists to gain excellence in education the “teachers need to be aware of what each and every student is thinking and knowing”. For external students, formative assessment provides the lecturer with an insight into the students’ level of understanding so that they are better able to assist them.

Within the STEPS mathematics courses, students are invited to submit their tests via email, fax or mail. All tests are stored and marked electronically using a Tablet PC and returned by email. Using a Tablet PC for marking enables the lecturer to annotate the test and provide prompt quality personalised feedback. Electronic submission, storage and the ability of markers to immediately access and mark tests through a shared drive, regardless of location, has reduced the turnaround time to process assessment from 1 to 2 weeks to as little 2 to 3 days. Distance students are the main beneficiaries of this efficiency, as they do not have to wait for their assessment to be submitted and/or returned to them via the traditional postal system. This process has an added advantage of allowing the lecturer to keep a permanent record of the student’s exact submission as well as an exact copy of the feedback returned to the student. As students need to be involved in the learning process, they are given the opportunity to discuss their progress and formative assessments with the lecturer and other students. It is recognised by Darkenwald and Merriam (1982, p111) that “Learning is more effective if the adult learner is actively rather than passively involved in the learning activity”.

Involving the student in their on-going formative assessment encourages engagement and collaboration between students and lecturers. This together with personalised feedback more effectively prepares students for summative assessment.

Feedback

As highlighted by Dekkers, Adams & Elliott (2011) the importance of feedback provided through formative assessment is both an important part of the learning process and a reciprocal process through which, both the student and the lecturer are better able to participate in the learning process. As the Tablet PC allows the lecturer to write on the student's test, personalised handwritten feedback (Figure 1) can be provided promptly, ensuring students receive feedback whilst the concepts covered are still fresh. If the student makes a mistake, the lecturer highlights the mistake and reworks the problem. This allows the student to see where they made their mistake and the correct working. Providing handwritten feedback is not only more authentic, but also provides guidance as to the correct setting out for a solution (Harrison, Pidcock & Ward, 2009).

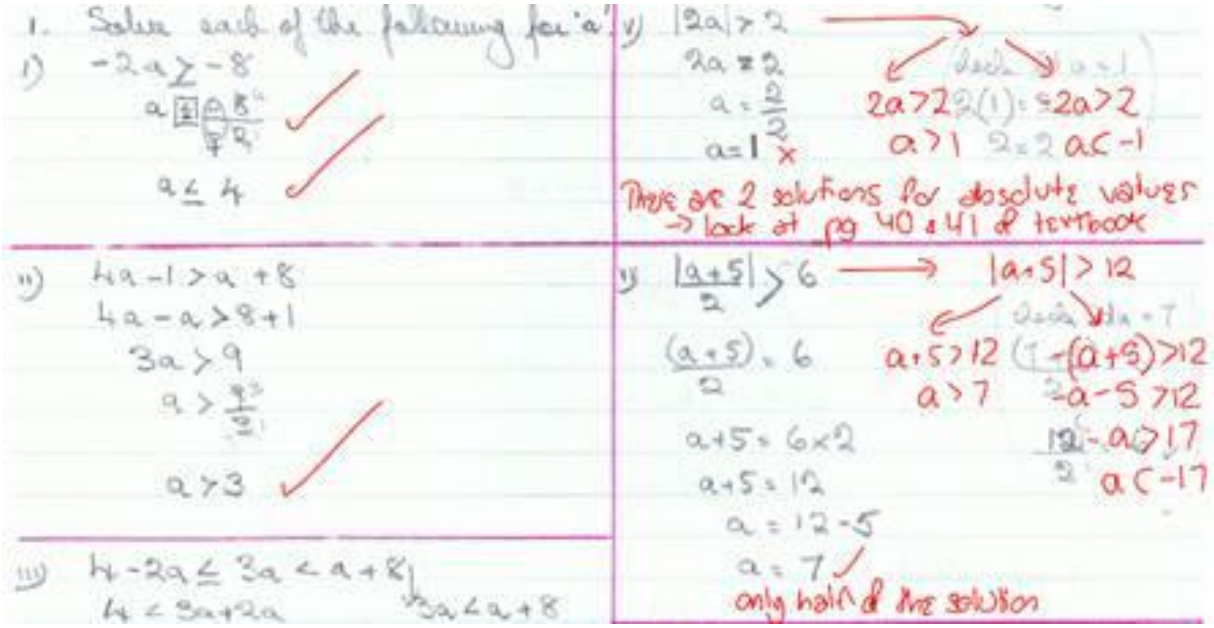

Figure 1 – Extract of an annotated formative assessment item

Submission of formative assessment enables the lecturer to monitor the student's progress and provide extra assistance if required. This feedback benefits not only the individual student but the entire external cohort (Dekkers, Adams & Elliott, 2011). Through the submission of formative assessment from multiple students, the lecturer gleans an indication of the general understanding of the course content. This enables shortcomings in the course content to be identified such that future modifications are able to be made to the course.

A study conducted in 2011 questioning preparatory mathematics students about formative assessment and feedback found that 66% of the students surveyed submitted their assessment via e-mail - indicating that this method was preferred over all other methods of submission combined (Adams, Dekkers and Elliott, 2012). Regardless of submission method 47% of students indicated that their assessment was returned in 2-4 days. Ninety-one per cent of the students found the feedback to be beneficial to their learning. Student comments included:

> *Marking was always very clear, and suggestions given to practice or redo anything I needed to go over. The teachers were always really quick, so was able to get immediate feed back of what to carry onto or redo anything again.*

Feedback given as part of formative assessment assists students to bridge the gaps between their present knowledge and required knowledge (Boston, 2002). Further, the quality of feedback received is crucial in improving learning (Sadler, 1998). The Tablet PC enables teachers to send students an electronic copy of feedback which contains hand-written annotations (Neal & Davidson, 2008) enabling prompt quality feedback. The integration of the Tablet PC, LMS, formative assessment and handwritten feedback is grounded in the theoretical framework of the seven principles for good practice in undergraduate education.

Theoretical Framework

According to the Seven Principles for Good Practice in Undergraduate Education (Chickering & Gamsen, 1987) that are endorsed by the CQUniversity Academic Board, good practice in undergraduate education:

1. Encourages contact between students and staff
2. Develops reciprocity and cooperation among students
3. Encourages active learning
4. Gives prompt feedback
5. Emphasises time on task
6. Communicates high expectations
7. Respects diverse talents and ways of learning.

Principles 1, 2, and 4 are easily achieved with internal classes, but through the use of discussion forums set up on the LMS, through regular email contact from course coordinators and prompt quality feedback on formative assessment; distance students can also be meaningfully supported.

In regard to Principles 3 and 5, a constructivist approach must be adopted, viewing the learner as the centre of knowledge creation with knowledge being constructed through the learner's experiences, actions and activities (Oliver, 2004; Hadjerrouit, 2007; Lee, 2009). Learners are driven by tasks and problems to engage with the content and discover things themselves (Adams, Elliott & Dekkers, 2010). Course coordinators and lecturers serve as guides providing a supportive learning environment and activities that engage students with learning.

Application for Engineering Courses

Central Queensland University offers a highly successful Engineering Programme, though the retention rate of the distance cohort is lower than desired. Based on the successful use of the Tablet PC, within the STEPS programme at Central Queensland University, in conjunction with formative assessment and electronic feedback, programme co-ordinators are investigating how this can be implemented in to engineering courses. Management of the Engineering School is encouraging the use of the Tablet PC and has purchased several machines that are available for staff to borrow. Given that Central Queensland University is moving toward electronic courses and assessment submission there has never been a better time to implement this technology. Therefore encouraging staff requires consideration of both the barriers and the motivators to use these resources.

Research Design

As step one of a grounded theory approach, the research team has reflected upon their perceptions of Tablet PC use in the existing environments. Step two will be an investigation of users' readiness to use the Tablet PC and whether they want to have a greater role in developing learning resources utilising the Tablet PC. The team is drawing upon the published data, to synthesise the knowledge from the different contexts of mathematics

communications and engineering. The research conducted for this project has been guided by the need to develop the strategies needed to help engineering academics to take up the use of Tablet PCs as a teaching/learning tool.

Considerations for Implementation (Outcomes from our Observations)

It has been observed that within STEPS, the level of Tablet PC incorporation into courses varies depending on discipline. The mathematics staff have fully embraced the technology, utilising its capabilities for internal lectures, video instruction and marking and feedback. However, language staff, despite having been supplied with the technology, have failed to implement the use of the technology into their courses other than to have created 'talking head' videos which could have been done with a camera. It is assumed that the differences may lie in the medium that is easier to convey the language. English is faster and easier to type while mathematics is easier to write.

User confidence is another issue to consider. Adams and Hayes (2009) found that both student and lecturer comfort with the use of the Tablet PC in class relied on the confidence of the user. Staff therefore require adequate training prior to any request to implement the technology. It has been observed that staff that are comfortable with the use of the Tablet PC tend to use it for greater purposes than those originally intended.

It is assumed that staff will be more inclined to use a Tablet PC that is available solely for their use rather than one which is available through a loan bank. Anecdotal evidence suggests that humans are more comfortable with the familiar. It would then be assumed that encouraging staff to utilise the Tablet PC would require the purchase of dedicated machines. Additionally, staff have indicated that reliance on the availablility of a loan machine at the right time impacts their willingness to use the Tablet PC on an ongoing basis.

The type and format of the assessment is a defining factor in suitability for marking with the Tablet PC. Preparatory mathematics courses at Central Queensland University have proven the requirement of a specific structure to facilitate ease of marking with the Tablet PC. It has also been observed that the type of response or feedback required for the assessment piece will determine whether the Tablet PC will be adopted. For example, some types of assessment lend themselves to 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 this.

Through the provision of electronic submission, a shared drive and a virtual private network (VPN), assessment is immediately available for marking regardless of the geographical location of the marker. Tests can be marked electronically, saved to the shared drive and e-mailed to the student thus removing the need to access paper copies or follow the print, mark, scan, e-mail regime. This also improves the efficiency of the moderation process. As assessments, markings and feedback are all saved on the shared drive, assessments can be easily selected and reviewed as part of the moderation process, or the accreditation process.

Other observed factors that that may affect the implementation of the technology include the size of the screen and the loss of the keyboard when using in tablet mode. These are easily overcome by the addition of a secondary screen and a wireless/bluetooth keyboard. However the lack of these resources may become a barrier.

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 Central Queensland University are completely paperless.

The team are conscious that these assumptions are based on their own observations, and are only step one in the research required to support a paradigm shift in the Engineering School. These observations need to be validated. To test how the observed motivators and barriers relate to engineering courses at Central Queensland University the research programme will continue with step two. This has now become the subject of a PhD study.

Conclusion

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. Current use in Central Queensland University STEPS mathematics courses shows 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. The integration of the LMS, formative assessment and the Tablet PC to provide personalised feedback assists in decreasing turnaround time of assessment and providing students 'real time' assistance.

Through the recognition of the observed positives and negatives of Tablet PC implementation in other courses, strategies will be developed to encourage the use by engineering academic staff. Step one of this project has identified by observation, the main barriers and motivators to the uptake of this resource. The next stage will be to develop the strategies to remove barriers and increase motivation to use the Tablet PC in formative assessment.

References

Adams, N., Dekkers, A., & Elliott, S. (2012). *Supportive frameworks that increase mathematical knowledge and confidence in students enrolled in bridging mathematics courses*. Paper submitted to the ISTE International Conference

Adams, N., Elliott, S., & Dekkers, A. (2010). *Videos That Click: Helping Bridging Mathematics Students Make the Connection*. Paper presented at the New Zealand Association of Bridging Educators 9th National Conference, Wellington, New Zealand, 29 September - 1 October 2010.

Adams, N., & Hayes, C. (2009). *Does teaching with a tablet PC enhance the teaching experience and provide greater flexibility?* Paper presented at the Australasian Tablets in Education Conference (ATiEC), 3-4 December. Retrieved from http://www.monash.edu/eeducation/assets/documents/atiec/2009atiec-nadineadamsclintonhayes.pdf

Boston, C., (2002). 'The concept of formative assessment. *Practical Assessment, Research & Evaluation*, 8(9) viewed 9 December 2009 http://pareonline.net/getvn.asp?v=8&n=9

Chester, V. (2008). Using Tablet technology for university lectures. *Bioscience Education, 12*. Retrieved from www.bioscience.heacademy.ac.ak/journal/vol12/beej-12-c5.pdf

Chickering, A.W., & Gamson, Z., (1987). Seven principles for good practice in undergraduate education. *AAHE Bulletin, 39*(7), 3-7.

Darkenwald, G.G. & Merrian, S.B, 1983, *Adult Education: Foundations of Practice*, Harper and Row, New York.

Davis, G. E., & McGowen, M. A. (2006). Formatice feedback and mindful teaching of undergraduate mathematics. In J. Novotna, H. Moraova, M. Kratka & N. Sthlikova (Eds.), Proceedings of the 30th International Conference for the Psychology of Mathematics Education, 1, p.241). Prague, Charles University Faculty of Education.

Dekkers, A., Adams, N. & Elliott, S., (2011). *Using technology to provide a supportive mathematical pathway into university*. Refereed Paper presented at the 8th Delta conference on the teaching and learning of undergraduate mathematics and statistics, Rotorua, New Zealand, 27 November - 2 December 2011.

Fleming, J., (2010). *A Framework for Academic Staff Online Course Development*. Theses Dissertation, CQUniversity.

Hadjerrouit, S. (2007). Applying a system development approach to translate educational requirements into e-learning. Interdisciplinary Journal of Knowledge and Learning Objects, 3, 107-134. Retrieved from http://ijello.org/Volume3/IJKLOv3p107-134Hadj296.pdf

Harrison, M., Pidcock, D., & Ward, J. (2009). Using technology to help engineers learn mathematics. The Electronic Journal of Mathematics and Technology, 3(2), 165-175.

Harry, K. (Ed). (2003). Higher education through open and distance learning. Taylor & Francis e-Library. Retrieved from http://books.google.com.au/books?hl=en&lr=&id=XqEcc-zMq-gC&oi=fnd&pg=PA57&dq=flexible+learning&ots=V_aCi1iezH&sig=D4fxD74_w83cIYgoznR1dScUtjg#v=onepage&q=flexible%20learning&f=false

Hattie, J. (2009) *Visible Learning Oxon*: Routledge.

Lee, J. (2009). From e-reading to e-learning: A pedagogical framework for online learning. ANZMAC. Retrieved from http://www.duplication.net.au/ANZMAC09/papers/ANZMAC2009-416.pdf

McLuhan, M., (1967) *The medium is the message. Q Fiore, NewYork*

MacKeogh, K., & Fox, S. (2009). Strategies for Embedding e-Learning in Traditional Universities: Drivers and Barriers. Electronic Journal of e-Learning, 7(2), 147 – 154. Retrieved from www.ejel.org

Millwater, J., (1988). *Teachers, Technology and Tomorrow – Towards Some Clarification*, *Teachers Forum*, vol. 56, no. 1, pp 2-4.

Neal, G., & Davidson, K. (2008). *Contesting ideas of innovative teaching practice with tablet PCs.* Paper presented to the Association for Active Educational Research Conference, Brisbane, December

Oliver, R. (2004). Pedagogy and Online Learning: An Interview with Ron Oliver. Retrieved 28 May 2010 from http://community.flexiblelearning.net.au/TeachingTrainingLearners/content/article_5545.htmSadler, R., 1998. 'Formative assessment: Revisiting the territory' *Assessment in Education*, Vol.5, No. 1 viewed 9 December 2009 http://www.ualberta.ca/~uts/documents/FormativeRevisited.pdf

Ozel, S., Yetkiner, Z. & Capraro, R., (2008). Technology in K-12 Mathematics Classrooms, School Science and Mathematics Association, Volume 108, Issue 2, Pages 43–88

Skilbeck, M., (2001), *The university challenged A review of international trends and issues with particular reference to Ireland.* The Higher Education Authority, Dublin

Siozos, P., Palaigeorgiou, G., Triantafyllakos, G., & Despotakis, T., (2009), 'Computer based testing using "digital ink": Participatory design of a Tablet PC based assessment application for secondary education', Computers & Education, 52 pp 811-819.

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