

# Digital Ink Technology for e-Assessment

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## 1. ABSTRACT

Current research has shown that lecturers marking electronic assignments, typically Word documents, are able to provide personalised feedback at a relevant point in a student's piece of assessment using paper technology such as a Tablet PC. Evaluation through in-depth interview and questionnaire shows that this was important to both students and lecturers alike. Some lecturers have felt that the Tablet PC allows greater creativity in assessment than technologies such as paper and pen and PC and keyboard input device. For example the use of colour linked to learning outcomes and grammar feedback, and the ease with which the eraser can be used for re-editing. It appears that the pedagogy has been extended from the traditional 'pen and paper' approach to the use of 'digital ink technology'. Students said that they liked the personal feel of the electronic hand written feedback. Reflective practice for lecturers was supported through forums and a wiki and was evaluated using virtual ethnography. Lecturers record a flow experience in assessment as either enabling or disabling their creativity in e-assessment. The potential for extending the pedagogy into graphical environments is also evident for such things as annotating graphs and diagrams, mathematical notation and scientific nomenclature.

**Keywords:** Assessment, Electronic-Ink, Graphics, Open-Learning, Pedagogy, Tablet PC, Technology

## 2. INTRODUCTION

Research into the use of Tablet PC in teaching and learning by Anderson [2] at Washington University and Reba [6] at Clemson University has been classroom based and highly innovative. Their work centres on using new technology in traditional settings but with potential to challenge existing classroom pedagogy. Research by Freake and Underwood [5] and Fisher [4] at the Open University in the United Kingdom has focused on evaluating the use of Tablet PC in distance learning. In particular the evaluation by Adams & Fisher [1] has focused on a comparative study of how lecturers use both PC and keyboard and the Tablet PC technology in e-assessment.

## 3. THE USE OF DIGITAL INK TECHNOLOGY FOR E-ASSESSMENT

### Background

Over fifty per cent of all assessment at the Open University is now submitted by students electronically, usually as a Word document. At the present time, the technology routinely used by lecturers for feedback in electronic assessment, is a PC and keyboard. On-line assessment of graphical environments, which include mathematical formulae, scientific nomenclature and diagramming, are areas of curriculum which are pedagogically challenging, for a lecturer, using a PC and

Keyboard. A comparative study was set up to study the use of PC and Keyboard and Tablet PC by five lecturers, assessing sixty students studying a nine month Foundation level ICT course. Open University lecturers are geographically dispersed throughout the UK, so a wiki and on-line forum was used to support their experiential development in the use of the pen based technology.

### Lecturers practice in marking e-assessment using a PC and keyboard compared with a Tablet PC

Using a PC and keyboard, lecturers routinely use embedded comments, macros and a variety of technical solutions to provide students with feedback on their assessment. Students' work is usually returned with changes to the lay-out of the original script and comments often not positioned at the most relevant position to the point being made. Sometimes due to software incompatibility between that used by the lecturer and the student, the student may be unable to see and access the feedback from the lecturer. PC positioned feedback (fig.1.top three examples) shows three different approaches to use of technology in e-assessment.

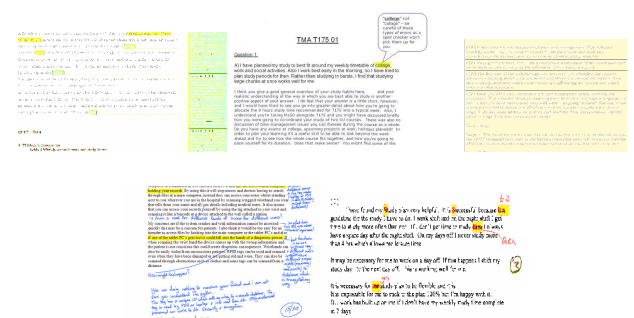


Figure.1. Examples of Key-Board and Pen Computing feedback

With a Tablet PC a lecturer (fig.1.bottom two examples) can annotate e-assessment with graphic and textual feedback. Using this technology a Word document can be converted into a file that creates a virtual layer above the student's work, retaining the coursework lay-out below the interactive top layer. The lecturer can then mark the electronic copy as they would with a pen on paper.

### Data collection and analysis

The evaluation included a nine month virtual ethnographical study of an on-line forum used for lecturer peer support and staff development, and perceptual insights were collected from 22 students and 5 lecturers. This was extended and included in-depth telephone interviews and a face-to-face focus group meeting with the lecturers. Questions focused on perceptions of the assessment process (e.g. positioning of feedback) and the impact of the technology on this process. The Strauss & Corbin [7] 'grounded theory' approach was taken for the analysis of the different data sources.

## 4. RESULTS

### Positioning of feedback

Questionnaires to both students and lecturers were useful in finding out about the importance of positioning of feedback. For both conventional technology and Tablet PC, the vast majority of lecturers believed that it is 'very' important to have the feedback positioned close to the point being raised in the coursework (see table .1.).

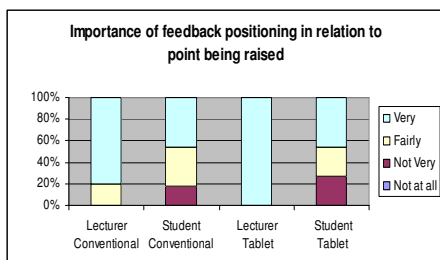


Table .1. Feedback positioning

What is interesting is that students perceived this as less important (over 20% saw it as not very important) in tablet PC assessments. Also the majority of students surveyed did not mind marking changing the lay-out of their work.

### Extending the pedagogy with digital Ink and creativity

Reflective practice in both the on-line forum and the face-to-face focus group meeting by lecturers, resulted in ideas being shared between each other in their use of the digital ink technology. These creative ideas included linking colour to learning outcomes and grammar. The ease with which the eraser could be used for easy and quick re-editing was also found helpful for diagramming. The on-line forum showed that, for some lecturers, the assessment process was both personal and emotional. Overall the wiki was thought useful for dissemination of ideas, rather than as a collaborative learning on-line tool.

### Flow in e-assessment

As a result of the in-depth telephone interviews with lecturers it was found that two out of the five lecturers were touch typists, with one having a speed of one hundred words a minute. This was found to be significant when these lecturers compared a less satisfying experience in e-assessment when moving from PC and keyboard to a Tablet PC. Those without touch typing skills found it to be a very satisfying experience when moving from a PC and keyboard to the Tablet PC. Both groups of lecturers record a 'flow' in the e-assessment task. This meant that for each group, of lecturers, the technology used was significant in allowing them to be able to record their immediate response to the e-assessment; otherwise for some of them their thoughts would be lost. Even if re-editing of initial feedback was needed it was considered very important by all lecturers to be able to use a technology that allowed them to quickly record their initial feedback.

## 5. CONCLUSIONS

Beechener, Fisher and Tait [3] at SoTL Commons 2007, considered making the technology fit the pedagogy. The results from this research support the idea proposed by Fisher, at that conference, that digital ink technology allows an extension to

pedagogy when compared to pen and paper technology. In other words this technology goes beyond replicating pen and paper. As an example, lecturers found it very easy to change the colour of the digital ink and loved the coloured electronic highlighter and some used the ink technology to develop their pedagogy further. They linked specific colours to learning outcomes and grammar feedback, in part to facilitate a deeper learning experience for their students in e-assessment.

The results also show that it is important to lecturers to be able to record their feedback in the form of either hand-written or typed text, as their thoughts first form in their mind. The technology a lecturer may chose to use in e-assessment may depend on the level of skill they have in touch typing. Alternative technologies such as audio and video could provide lecturers with new ways of recording their feedback quickly.

The results also show that the use of a digital ink technology interface provides a way of processing graphical representation electronically. Subjects such as chemistry call for an understanding of abstract ideas, which have been traditionally taught two dimensionally. The digital ink technology provides the potential for chemistry to be taught three-dimensionally and open up a completely new pedagogy for teaching and learning this complex subject.

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