Utilising Tablet PCs in Tutorials to Aid External Students

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Abstract: A tablet PC (a computer with a special screen so a stylus can write directly into an active program) was used in a tutorial setting to record pen-strokes and audio subsequently edited as a video. Because the subject primarily involved mathematical manipulation, ordinary text-based presentations might not be as beneficial. The intention was to provide a fuller tutorial experience for external students compared to the usual static page of worked solutions, which does not allow the student to discover the deeper thought processes behind the flow of the solution. A broader range of senses can be engaged, deepening the learning process and assisting those students who tend to learn aurally. Students were surveyed regarding their impressions of how useful the videos were in conjunction with the static page of worked solutions. Also studied was the in-class learning experience due to the use of the computer instead of the traditional board.

Introduction

The University of Southern Queensland has a large cohort of external students, comprising approximately 70% of engineering classes. In an effort to improve course delivery, a number of academics have been trialling the usage of tablet PCs. The screen of a tablet PC can be rotated about two axes, so that it can open and close like an ordinary laptop, but can also be folded down into the "closed" position with the screen facing outwards. This enables it to be written on using a stylus, so that it can record pen strokes similar to ordinary hand-writing. (Some of the latest tablet PCs also have touch-screen capabilities. A graphics tablet, which looks like a large mouse-mat, can also be connected to a computer to record pen strokes; a tablet PC allows the user to take their software and configuration anywhere.) The advantage of recording the pen strokes on a computer is that a video can be created of the writing as it is performed. This can have an audio recording to accompany it, which increases the information density by adding thought processes behind steps in the methodology without overloading the visual senses or filling the page with an extraordinary amount of writing. The videos can then be made available on-line for the students to access.

A number of trials into using tablet PCs in classes by lecturers and students have been performed prior to this trial (e.g. Reboli, 2007; Benoit & Shakshuki, 2006; Loch & Donovan, 2006), with the emphasis on flexible delivery and often with the static output made available. In this trial, the focus was on using the tablet PC in tutorial classes and using the output to create videos that distance-education students could access. The goals were to augment the learning process for students who could not attend tutorial classes (so that their experience was closer to being an on-campus student), and supplement the learning process for on-campus students (who had more flexibility in their learning behaviour).

Video Creation

To create the videos, presentations were produced in Microsoft PowerPoint with most of the screen blank for the hand-writing. When using graphs or tables, planning is required to insert those slides; it is better to prepare more slides for writing than necessary since they can easily be deleted later. Using a tablet, the pen-strokes are naturally allowed in the Slideshow mode of PowerPoint by using the pen function for the cursor (this can also be utilised by using a mouse). The software used to record the pen-strokes was Camtasia Studio 6.0.1, which works as a plug-in or add-on to PowerPoint to record

the video, then as a stand-alone program for editing and producing video or audio files. The author preferred to record the audio simultaneously to the hand-writing, since the hand-writing can be paused for an extended explanation. Figure 1 shows a sample completed screen.
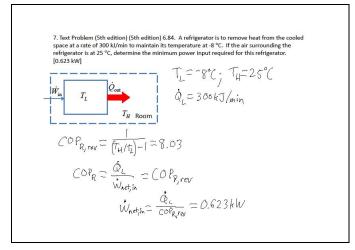

Figure 1: Example snapshot of completed screen.

The videos can be created by recording the in-class session ("live") or by separately making a "studio" recording in the office. After the first effort in recording a live session, the author decided to only make studio recordings because the editing process was simpler for two reasons:

1. When a mistake was made, there was a clean stop in the recording, with the section re-recorded. Some of the hand-writing was deleted: a simpler prompt in the editing process to find a section that should be removed. With a live recording, any mistakes or stumbling over of words had to be carefully listened for and it was much more difficult to remove them or sometimes impossible if they coincided with some of the hand-writing, which needs to be preserved. Therefore less concentration was required in the editing stage and so the overall time required was reduced.
2. In a classroom situation, some interaction with the students was preferred, so this would lead to long tracts of silence or encouragement of ideas which would be edited out to reduce the overall file size of the recording. It might be difficult to have a coherent structure after editing.

The studio recording was normally made after the in-class session because often some unforseen theoretical difficulty was encountered, which could be explained in the final video. In the survey, the students were asked a blind question about whether they noticed a difference between an edited live recording and the studio recordings, and they did not. So the preference for studio recordings is largely that of the author for his convenience, rather than any increase in perceived video quality.

Results and Analysis

In this section, the survey methodology will be described, followed by the results and analysis.

Survey Methodology

Students completed a once-only, anonymous on-line survey with multiple-choice and short-answer questions, running for the last third of the semester. Before the survey, the tablet PC was solely used in all tutorial classes; after two weeks, the whiteboard was used exclusively for a few weeks. The tablet PC was used in the final tutorial because the process required interpolation from a graph; this would traditionally have been done using Over-Head Transparencies (OHTs).

There were nine questions designed for trend identification; some examples are: gender, age range and English proficiency. The remaining questions were grouped to identify particular issues:

1. The students' experiences with viewing the created videos of the worked solutions
2. Identifying quality differences between recording videos in the class and in the office; and
3. The student experience of using the tablet PC in the class.

Group 2. questions were blind with the videos solely identified by problem number.

Survey results

Most identifying questions did not yield statistically significant results. All respondents were male; all claimed proficiency in English; and all internal students were aged 25 or younger, while all external students were aged 26 or older. Variation in age within each group did not produce significant trends.

Figure 2 shows the most crucial factor: the students believed that their learning was enhanced because of the videos. The internal students showed the weakest improvement: unsurprising since the videos were supplementary to the on-campus tutorials; for external students, they were substitutes for on-campus tutorials. The following discussion will elucidate what caused the learning enhancement.
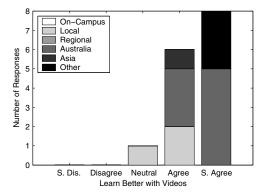

Figure 2: Student opinion on learning enhancement due to videos.

Student experiences with viewing the videos

In Figure 3 are shown the students' opinions on the video accessibility while streamed on-line, filtered by the type of internet connection used. Figure 3(a) shows the results for the lower-resolution videos (400×300, approximately 0.63 MB/min), while Figure 3(b) shows the results for the higher-resolution videos (640×480, approximately 0.87 MB/min). The underlying factor is the student's internet connection, rather than the student's location. Respondent #13 requested that the videos be available for downloading, rather than just available as streamed media. This was an external student located in rural Australia that had an ADSL connection, but responded "Agree" to both questions in Figure 3. This led to another consideration that download quota (a limit on the total MB able to be downloaded per month) is another strong consideration for students; surcharges on excess data download are normally disproportionately high relative to the standard charge for the quota. As a consequence of this, the videos were subsequently made available solely for download to the students' computers.
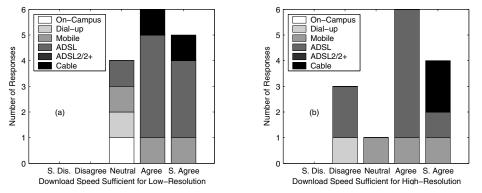

Figure 3: Students' experiences of streaming videos.

The results for students' opinions on their experience of viewing the videos are in Figure 4, filtered by internet connection in Figure 4(a)–(c) and by location in Figure 4(d)–(f). Respondent #13 was among those to find the videos were not easy to access and view—Figure 4(a)—because the links to viewing the videos were all located vertically on the course's homepage with all other course material. This resulted in a cluttered website requiring substantial scrolling to reach the latest item. Because of the number of videos that were created (one video per problem), a separate webpage should be solely devoted to videos; perhaps separate webpages for each type of video (lecture, tutorial, etc).

Figure 4(b)–(f) show that having the worked solutions produced by recording the pen-strokes of the tutor, while also providing a commentary on some of the thought processes behind the methodology, helped the learning of the students. Some important considerations, based on student comments, are:

- The audio is a crucial part of the success because it is often easier to add verbal comments as deeper explanation than to write out every single thought process, particularly for the "neatness" of the worked solution. Concepts "clicked" because of something that was said.
- External, mature students in particular appreciated seeing as many steps in the mathematical derivation as possible, since their memories of the fundamentals of high-school mathematics have faded due to lack of use.
- Some internal students prefer knowing that the videos will be available since they then choose to NOT write down the worked solutions in class. This is because a lot of concentration can be required to copy what is on the board, which diminishes the ability to understand what is going on—including listening to the tutor.
- Internal students are comfortable in the knowledge that if they miss a class (e.g. through sickness), they can catch up by viewing the videos without requiring a private session with the tutor.
- The videos can be paused at any time, so students can contemplate a particular section.
- External students feel more like they are on-campus, because the gap in delivery is reduced by obtaining a worked solution in the same manner as on-campus students. There is still a gap since the videos are not interactive.
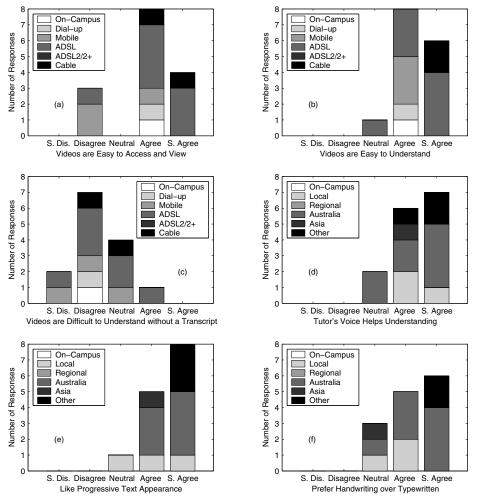

Figure 4: Student opinions on videos of worked solutions.

Production of completed screen snapshots

PowerPoint shows all pen-strokes added to each slide, which can be printed to pdf file format; these were provided to the students. The students were strongly in favour of supplying the snapshots

(Figure 5), since they provide a quick-reference resource away from the computer. About one-third of respondents printed the snapshots before viewing the videos to annotate what was said—this is similar to supplying lecture notes before a class and students being able to annotate additional information.
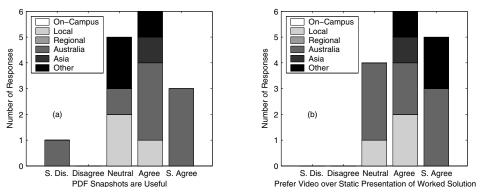

Figure 5: Student opinions of the static output of the videos.

Difference between live and studio recordings

The students perceived that there was a difference between the edited live recording and the studio recordings, which could be because they were asked if they noticed a difference! None identified why it was different and in general they did not consider it worse than other recordings. Some recordings were of lower quality since inferior microphones were used due to limited availability of better ones.

In-class experience of the tablet PC

Figure 6 shows the students' experiences with the tablet PC being used in class. Numerous external students responded, despite them not attending the tutorials; the discussion is restricted to the internal students' responses. The author suspects that the external students assumed that the videos were produced from the in-class tutorials and therefore preferred the tablet over the whiteboard (the lecturer provided photographs of the whiteboard from lectures). The internal students preferred the usage of the whiteboard instead of the tablet PC, which is principally due to the limited available space before the screen must be cleared: this was directly assessed in Figure 6(d). The internal students attended the tutorials and generally copied what was written down despite the availability of the videos since:

- Human interaction is generally faster because questions are answered immediately. If the tutor is unsure of what the student means, clarification is easier.
- Typesetting equations is difficult in e-mails and students may not have access to a scanner or neat enough handwriting to convey their efforts effectively.
- In an effort to cement the information as best as possible, they wrote the information down, which provided an additional opportunity for the information to be processed in their minds.
- It provided immediate reference material for solving problems during the rest of the session.

The student who did not copy the notes in class said that he preferred to concentrate on the tutor and try to understand the material as best he could during the tutorial. He knew that he could revise this information and copy it down or print it out at home, without the distraction of his class-mates.

Conclusions

A trial was performed using a tablet PC in a tutorial session and recording videos of worked solutions. The aim was to decrease the gap between external students (predominantly mature-age students) and internal students. The survey results show that all students liked the videos because they contained fuller explanations of the thought processes behind the formulae that were used, providing an excellent revision tool as well. The author found that recording "studio" sessions of worked solutions was easier to edit than "live" recordings from class, reducing the total time required for production. The internal students generally preferred that the tablet PC was not used in tutorial sessions; their behaviour was not significantly altered by the delivery method. One deficiency of using the tablet for tutorials was identified: that a limited amount of information can be displayed on the screen before it must be cleared, while much more can fit on a set of black- or white-boards.
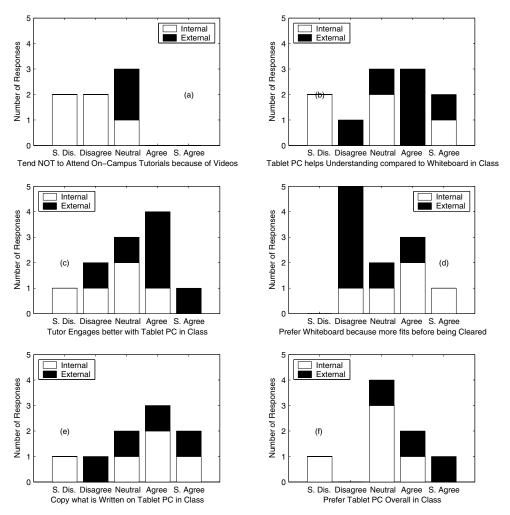
Figure 6: Student experience of tablet PC in class.

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