Student usage of videos containing worked solutions

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***Abstract**: During a prior course offering, a tablet PC was used to generate videos of worked solutions to tutorial problems. This was found to be effective for engaging distance-education students who do not have the capability of attending regular tutorial classes. The benefits of the videos come from the solutions being hand-written on the tablet PC screen while the tutor spoke about the problem. The usage of hand-writing brings a sense of humanity to the solutions, while the audio stream contains a higher information density, thereby enabling background information to be conveyed more thoroughly and substeps described. For the next offering of the course, these videos were made available to the students before the semester began, rather than as the semester progressed. The current study assesses how the students have utilised this tool and how their study behaviour may have changed by having access to the videos throughout the course.*

Introduction

Approximately 70% of enrolments in engineering at the University of Southern Queensland are distance education students. As such, different techniques are required to deliver material besides the traditional classroom scenario. Horváth *et al*. (2009) reviewed advances in technology that have enabled greater use of the internet to deliver content and provide staff-student and student-student interaction. In addition, they discussed different tools for presenting this content that have been developed. One tool which provides an interesting method of delivering course content is a Tablet PC. This is a laptop computer whose screen can be written upon with a stylus (potentially also being used as a touch-screen), with the screen able to be rotated about two axes so that it can be closed with the screen on the outside. Among other features, this allows handwriting to be captured and stored digitally, with software enabling the encoding of the handwriting as video. Similar technology has been used in various PDA devices and graphics tablets, the latter being similar to mouse mats that are linked to the computer via some data connection. New devices such as the iPad® appear to be predominantly touch-screen devices, so do not capture handwriting in the same way that tablets can. So while these devices will find some applications in education, it appears they will not yet replace Tablet PCs because being able to use handwriting is seen to be fundamental in students' acceptance of the technology, as found by any authors using the technology (see the list below).

As with any tool, knowledge of its functionality results in creative applications. Tablet PCs are no exception, and a search of the literature reveals a variety of purposes for which they have been used within educational contexts:

1. To present lectures (Benoit and Shakshuki, 2006, Loch and Donovan, 2006, Reboli, 2007, Klappa, 2008, Walker *et al.*, 2008)
2. To record lectures (Baldwin and Johnson, 2001, Winer, *et al.*, 2001, Thai, Morita and Iwasaki, 2007, Palmer and Hall, 2008, McKechnie and Kalavally, 2009, Thompson and Dekkers, 2009)
3. To record worked examples of problems (Wandel, 2009)
4. For live online delivery of classes (Winer, *et al.*, 2001, Chen, Kinshuk and Wang, 2007, Thai, Morita and Iwasaki, 2007, Palmer and Hall, 2008, Schaefer *et al.*, 2008)
5. Student use in class as interactive tools (Benoit and Shakshuki, 2006, Hamilton and Hurford, 2007, Thai, Morita and Iwasaki, 2007)

6. In graphics/design classes (Benson, Krawczyk and Figueiredo, 2006, Contero *et al*., 2006, Naya, Contero and Aleixos, 2007)
7. Marking assignments (Steinweg, Williams and Warren, 2006, Freake, 2008, Brodie and Loch, 2009)
8. In the future, potentially everything! (Hinrichs, 2004)

Methods 1–3 and 7 are predominantly passive: the teacher uses a tablet to prepare material that the students access. Methods 4 and 5 are interactive: the students may use a tablet to provide feedback while the class is active. Method 6 is active: the students use the tablet to perform activities. Most of these methods do not require the usage of a tablet: they are largely software driven and a tablet merely provides the ability to include handwriting electronically. For instance, Ridwan *et al.* (2001) used a computer to record, among other things, introductions for laboratory practical classes using a video camera filming a person performing the activities.

Background to the Current Study

Wandel (2009) reported the implementation into a thermodynamics course of recordings produced for worked examples. These were produced separately so that each file contained the working for one problem. From an editing perspective, it was found that the optimal method of producing these recordings was in a "studio" environment (the office), rather than recording the tutorial live. One reason for this was that the tutorial was run rather interactively, so there were numerous "dead" points as student responses were elicited. In addition, any errors can be more easily edited out in a controlled environment where recording can be stopped and a second "take" can be made: otherwise, ensuring the integrity of both the audio and video streams becomes very difficult. The recordings were produced after that week's tutorial class, so that any difficulties encountered could be incorporated into the recordings. As such, they were only available in a relatively synchronous fashion: after the material was covered in class, the videos became available.

Although most of the literature reports only positive experiences when using a Tablet PC, others [Brodie and Loch (2009), Wandel (2009)] found that this was not universal: students did not like the use of the technology within the classroom. This was principally due to solutions being rather lengthy, so requiring a number of screen refreshes to be able to cover the full solution. This made the solution layout rather messy (to try to limit the number of screens required) and also meant that previous aspects of the solution became unavailable (which was also commented upon in the current study). However, all the students liked the availability of the recordings and generally felt that they improved their learning. The usage of audio increased the information density that can be applied, because comments can be made and deeper explanations given that would not normally appear on a page of worked solutions. The ability to see the handwriting appear as a solution was derived gave an aspect of humanity to the work, which provided a greater connection with the teacher. Unlike in a tutorial, the student was able to pause the teacher when they wished to contemplate further or note something that was covered. Because file sizes could be large and many of the students had download quotas which restricted the number of MB they were able to download, students preferred being able to download the files to be played on their machines, rather than streaming the videos across the internet.

The Current Study

Using the same videos as had previously been created, CDs containing the files were mailed with the usual study materials to the students before semester started. This allowed flexibility for those students who study asynchronously: work commitments can often lead to students being unable to pursue their studies for periods lasting weeks, so they manage their time accordingly.

A similar survey to that run previously was performed, with results (from 5 valid responses) being statistically similar to those obtained by Wandel (2009) and summarised in the previous section. Of particular note was that on-campus students continued to attend tutorial classes because only 1 or 2 of the questions in each tutorial sheet (approximately 25%) have videos. They felt that this was not

sufficient for their learning purposes. This was supported by one external student who attended some of the tutorial classes. He commented that much more information was presented in the tutorial sessions than was covered in the individual recordings, so he attended as many sessions as he could. Some other general comments from the students on the recordings are:

- It gave a good understanding whilst learning and then later was a good reference if I was having difficulty with a problem
- I was able to pick calculation procedure and the tute videos broadened my understanding of thermodynamics, small phrases used throughout the tutes also developed my understanding of the subject. I didnt always need them, however they were a very useful tool. thank you.
- Having read the text book thoroughly and having gotten stuck and re reading the same material does not help very much. It is a slow and laborious process. Seeing the lecturer solve problems and describe the methodology behind the problem greatly speeds up the learning process.
- The videos work through the problem far more casually than in the face-to-face tutorials, with more time given to each question. The videos set the solution out on a page and work through it in a logical manner as i would hope to replicate in an exam.
- Phrases and comments made throughout the tutes developed my understanding of the subject matter. I am hoping such videos are used for learning tools in other subjects such as dynamics.
- videos were really useful, it would be good if the tutorials could be videod and supplied to the external students as well.

Further data was collected on the student usage because the videos were available from before the start of semester, rather than progressively during the semester. Figure 1 shows the student responses; the tendency was to use them consistently through the semester. Some comments from the students were:

- I found that there were no tutorial videos available for the first 3 modules studied, once I reached the modules for which there were videos available I found them extremely useful
- Later modules in the course were harder than those at the start. I found i didn't have to consult the tutorial videos in order to solve problems from earlier modules.

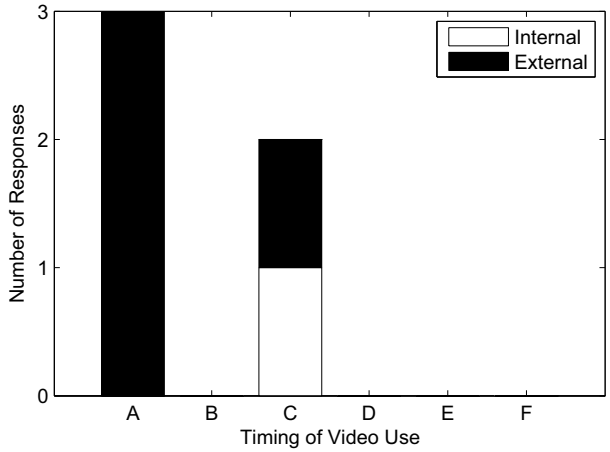

Figure 1: Pattern of student usage of videos throughout semester. The options were: A = "consistently throughout", B = "more at the start than the end", C = "more at the end than the start", D = "only when attempting assignments", E = "only when preparing for the exam" and F = "only when attempting assignments and preparing for the exam".

In Fig. 2 are the responses for the order in which students used the videos compared to the other available teaching material. It is clear that most students used the videos as a secondary learning tool to supplement their understanding. This is not surprising because the purpose of the videos is to provide descriptions of how to solve problems, rather than teach the underlying theory.

Of further interest is the student participation in the course. A common method for students to learn is by posting questions on the fora and engaging with their peers. While the usage pattern for 2009 was fairly constant [Fig. 3(a)], usage in 2010 was largely at the beginning of the course [Fig. 3(b)], with a large number in the middle and little else. Note that each assignment was worth 10% of the course,

but in 2009 there were two assignments [due weeks 8 (before Easter) and 14], while in 2010 there were three assignments [due weeks 4 (before Easter), 10 and 13]. Twelve of the responses in 2010 week 10 were due to errors in the assignment questions. The exam was in week 16 in 2009, while it was in week 17 in 2010. The total responses for each topic over the semester are listed in Table 1. It is apparent that while the enrolments were much the same and the number of postings pertaining to assignments were reasonably similar, there were significantly lower levels of discussion pertaining to theoretical questions and the exam. It is suspected that the provision of the tutorial videos for the duration of the semester has encouraged many external students to conduct individual study, to the detriment of those who prefer to engage in group discussions.

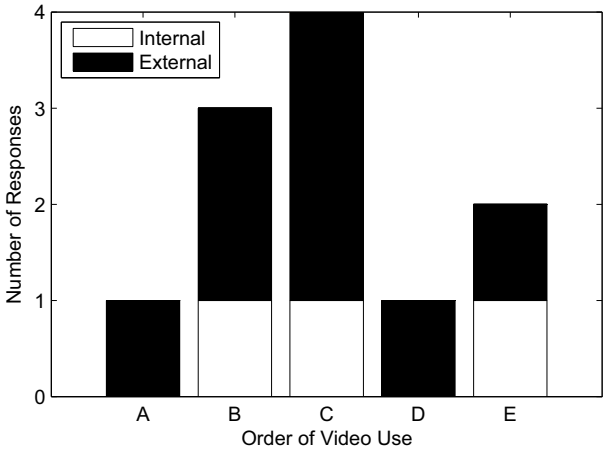

Figure 2: Pattern of student usage of videos compared to other material. The options were: A = "before anything else", B = "after using the study material", C = "after reading the text book", D = "after viewing the lecture notes" and E = "after becoming stuck on a question".

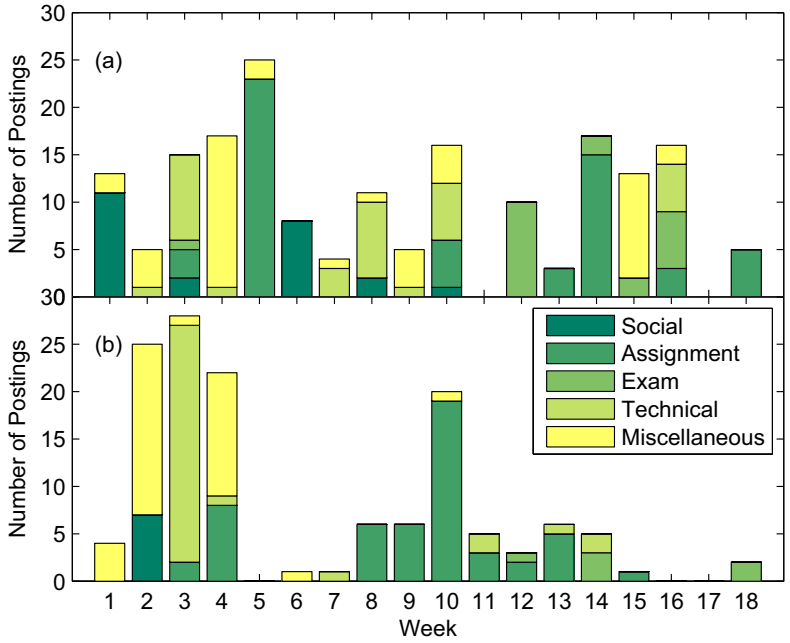

Figure 3: Number of student postings on fora for: (a) 2009; (b) 2010.

Table 1: Total student postings on fora for each general topic. The final columns list enrolments.

Year	Miscellaneous	Technical	Exam	Assignment	Social	**Total**	**Enrolment (External)**	**Enrolment (Internal)**
2009	47	34	21	57	24	**183**	**56**	**36**
2010	38	19	6	65	7	**135**	**66**	**25**

Palmer and Hall (2008) found a similar result in that the webpage containing the (audio only) files was accessed more times during the semester than the online discussion area. They did not comment whether they felt that this was detrimental to student learning. However, a subsequent study (Palmer and Holt, 2010) has found that students (on-campus and external) in general do not consider contributing to discussion fora an important component of their learning experience. This is despite considering the reading of others' contributions as being important and having a (perceived) consistently high usage; the authors surmise that this is due to the participation not being assessed. A study based on forum usage which was explicitly graded (Palmer, Holt and Bray, 2008) found that approximately one-quarter of students displayed a healthy, active presence, with over one-half appearing to strategically post with the sole intention to receive marks and the remainder not attempting to receive those marks. However, there was a distinct positive correlation reported between the number of messages posted and final overall grade.

Comparison of the student overall grades for the two years shows little variation in the total marks received when comparing Pass/Fail percentages or HD/A percentages. A deeper longitudinal study is required to ascertain whether there is any statistically-significant difference in the grades achieved before and after the tutorial videos were made available to the students.

Conclusions

Videos of worked solutions have been created using a Tablet PC to assist distance education students by providing a tool that is closer to an in-class experience than is generally provided by static teaching materials. Because the videos were available before semester started in the latest offering of the course, instead of as the semester progressed in the previous offering, the current study focussed on the impact on student behaviour. It was found that students tended to use the fora significantly less than in the previous offering, which adversely affected those students who preferred to engage with the cohort through this means. Whether this has an overall detrimental performance on student performance is unclear, because the average grades that were achieved did not change significantly. Further study is required in this area to determine the level of influence this has.

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