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Using Digital Lectures to Assist Student Learning

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Abstract

This study explores the use and usefulness of digital lectures as a resource to augment conventional face-to-face lectures for students in an undergraduate business course. Twelve digital lectures were provided to students enrolled in a third year finance unit of study. The digital lectures were prepared at the desktop using proprietary software to record on-screen activity (including lecture slides, real-time annotations and demonstrations) and voice-over narration. Each lecture was made available online and on CD concurrently with the face-to-face lecture (attendance at which was voluntary). Twelve principles of multimedia design (Mayer 2009), based on dual-coding theory (Paivio 2006) and a model of the working memory (Baddeley 1992; Baddeley 1999), influenced the design of the digital lectures. A framework was developed to explain the potential learning benefit for students from using digital lectures. It highlighted issues of access, control and learning as being important. A voluntary survey was independently conducted after the semester finished to establish how students used the digital lectures and whether they found this resource aided their learning. Forty students from a class of 52 completed the survey. Students reported using the digital lectures to supplement rather than replace the face-to-face lectures. Of the twelve lectures in the unit, students reported attending nine face-to-face lectures and viewing nine digital lectures, on average. A range of positive statements about the value of digital lectures to aid student learning recorded very high mean levels of agreement. In these student responses, all three characteristics of access, control and learning emerged to explain why students used the digital lectures consistently and regarded them as a valuable resource. The high value placed by students on these digital lectures is subsequently confirmed by anonymous student unit evaluation information collected by the university.

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Introduction

Student populations are becoming increasingly diverse, and many students have to juggle demands of work, study and family, giving rise to stronger demands for flexibility. At the same time, the traditional-age students of the "net generation" (Oblinger and Oblinger 2005), having grown up with the ready availability of information, bring an expectation that learning resources will be available anytime, anywhere (Caruso and Kvavik 2005).

The most recent 2007 report on online learning in Commonwealth countries concluded that while there has been growth in on-line learning, the growth has been incremental, and the expected shift away from the traditional face-to-face provision has not occurred (Becker and Jokivirta 2007). The authors argue that "the vast majority of growth in the formulation and integration of institution-wide online learning strategies has focussed on the enhancement of on-campus teaching and learning rather than off-campus delivery" (Becker and Jokivirta 2007, p.39). This finding is consistent with the findings of the 2004 report which found that more than 80% of responding universities used the online mode to provide on-campus flexibility (Garrett and Jokivirta 2004, p.41). However, the authors concluded that, despite predictions to the contrary, online learning had not challenged the traditional on-campus learning model. They argued that "significant impact on an activity as complex, tradition-bound and semi-conscious as learning will … take much longer to realise" (Garrett and Jokivirta 2004, p.41).

This sentiment has also been echoed by Smith, Salaway and Caruso (2009). In a US-based survey, they concluded that respondents wanted the use of IT to be balanced with the human touch in their learning environment. A final open-ended question of their survey saw students citing a preference for "real books and people" and said that "shiny new tech is still not a substitute for well-trained, passionate instructors" (Smith, Salaway et al. 2009, p.12).

Against a backdrop of evolution rather than revolution in student learning, this study explores how a group of students responded when offered digital lectures in addition to conventional face-to-face lectures. In reality, the research is a pilot study of how students use digital lectures. The hypothesis is that students will blend their use of digital and face-to-face lectures, rather than becoming exclusive users of digital lectures or face-to-face lectures.

In terms of a link between this research and the conference theme of "Educating For Employability", digital lectures are being increasingly used by employers to train staff. The exposure that students have to digital lectures as a result of this research should increase their IT literacy in a working environment.

Digital Lectures in Teaching

The word "digital" can be used to designate "… a digitally generated or computer-mediated counterpart of a previously existing object or action"(Oxford English Dictionary 2002). Adapting this meaning of the word, a digital lecture is defined here as a digitally generated or computer-mediated counterpart of a face-to-face lecture. While digital lectures can potentially take a variety of different forms, in their essence they are a series of words and/or pictures in a digital form. At one end of the scale, this description can cover an audio recording of a face-to-face lecture which is accessible on-line. It could also cover a series of PowerPoint slides in a digital form. At the other extreme, in terms of resource requirements, is a digital recording in a dedicated studio of a lecture which then has interactivity features incorporated. The capturing and streaming of face-to-face lectures in universities, is an increasingly common form that digital lectures are taking.

The Type of Digital Lecture Used in this Study

The digital lectures used in this study differ from standard recordings of face-to-face lectures made available online. Each digital lecture was recorded prior to the face-to-face lecture. Recording was done at the desktop using proprietary software to record on-screen activity and voice-over narration. The on-screen activity included PowerPoint slides, Word documents, Excel files, scanned images, websites, video images of the lecturer to accompany

the narration, and real-time annotations from a drawing tablet. Each digital lecture was made available to students as a Flash file. An advantage of the Flash file format was ease of viewing: it could be viewed in a web browser, such as Internet Explorer, without the need for students to download any additional software.

Design issues with Digital Lectures

(Mayer 2009) has defined multimedia as involving the presentation of material using both word and pictures. Under this definition, the words can be spoken and/or written and the pictures static and/or dynamic. According to this definition, the digital lectures used in this research qualify as a form of multimedia. This is likely to be an important connection to make, given the extensive research that has been done on the way that people learn from words and pictures.

The benefits of using a multimedia format for the digital lectures are supported by research in the field of cognitive science and, in particular, Richard Mayer's cognitive theory of multimedia learning (Moreno and Mayer 2000; Mayer 2005; Mayer 2009). This theory proposes that meaningful learning can be enhanced by presenting information in both visual and auditory formats. This theory is based on three main assumptions. The first of these is the dual-channel assumption, where separate channels are available for receiving verbal (spoken) and visual information in sensory memory. The key references here are Paivio's (1986) dual-coding theory and Baddeley's (1998) model of the working memory. The second assumption is the limited capacity assumption of Sweller's (1988) cognitive load theory, where working memory has limited capacity to deal with unfamiliar incoming information. And the third assumption is the active processing assumption, where humans actively process information in order to build mental models through cognitive processes including "paying attention, organizing incoming information, and integrating incoming information with other knowledge" (Mayer 2005, p.36).

Multimedia learning therefore takes place when new information is organised and connections (or structural relations) are made between the verbal and visual elements within the working memory. These are then integrated with existing knowledge within the long-term memory (Chandler and Sweller 1991; Van Merrienboer and Sweller 2005; Mayer 2009). Figure 1 (Mayer 2009, p.61) shows the progression of the three cognitive processes that constitute multimedia learning. These are selecting, organising and integrating along the two processing channels.

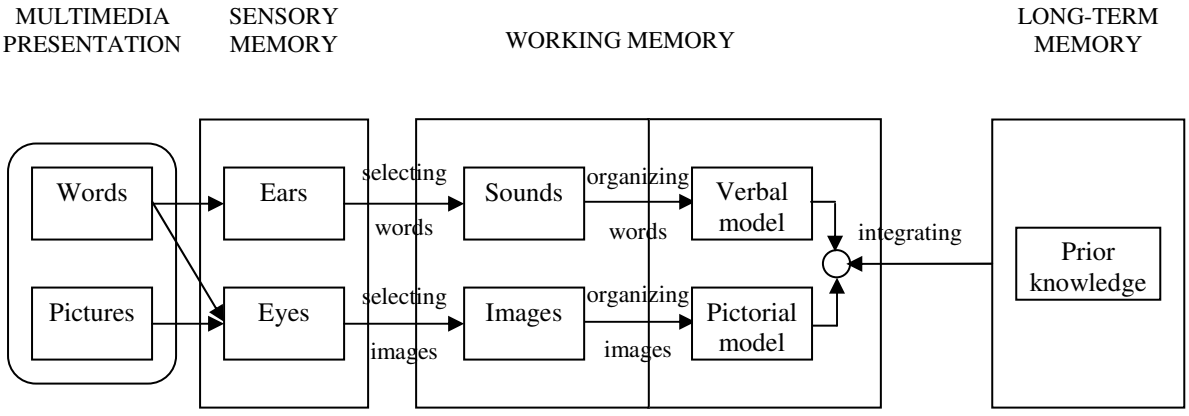

Figure 1: Cognitive theory of multimedia learning
Source: (Mayer 2009, p.61)

Cognitive overload has become a “red flag” in multimedia design (Sorden 2005). So while presenting information in both verbal and visual formats can promote meaningful learning, superfluous information presented in either mode can hamper learning.

These theoretical foundation have led Mayer (2009, p.266) to develop twelve principles of multimedia design. These principles have, in turn, guided the design of the digital lectures used in this research. Mayer (2009) organises his twelve principles according to the theoretical function that they serve. To this end he identifies three theoretical functions: reducing extraneous processing, managing essential processing and fostering generative processing. Tables 1 - 3 provide a summary of the three theoretical functions and their twelve related principles.

Also covered in Tables 1 – 3 is the impact that each principle had on the design of the digital lectures used in the present study. The argument advanced here is that these digital lectures were designed so as to be consistent with Mayer’s twelve principles of multimedia design.

Mayer (2009) has also advanced two boundary conditions for design principles, which are summarised in Table 4. In that table it is argued that these two boundary conditions probably increase the multimedia design effects due to the newness of the concepts and the inherent difficulty of the mathematical and graphical exposition used in finance.

It is also possible that there is a third boundary condition at work with these students; that of language familiarity. Many of the students studying this finance unit are international students for whom English is a second language. It could be argued that the multimedia design effects will be stronger for these students. One rationale for this argument is that the ability of the student to pace the delivery of the content will allow the student to learn better. Discussion later in the paper highlights the evidence for this boundary condition in the results for this study.

Name of the principle	**A Summary of the principle (Mayer 2009, p.267)**	**Impact on the design of the twelve digital lectures**
1. Coherence Principle	"People learn better when extraneous words, pictures, and sounds are excluded rather than included."	A number of steps were taken to exclude extraneous content: avoiding displaying more than one application at a time, zooming and scrolling the screen to focus only on relevant content in that application, and erasing screen annotations that were no longer relevant.
2. Signalling Principle	"People learn better when cues that highlight the organisation of the essential material are highlighted."	The first part of each lecture introduced a set of learning objectives. These learning objectives provided a structure for the content. Regular references were made to these learning objectives in the coverage of the content. The last part of each lecture revisited the learning objectives and how they had been addressed in the lecture.
3. Redundancy Principle	"People learn better from graphics and narration than graphics, narration and on-screen text."	Words were spoken rather than written, although some written words, via annotations or static text, were used to reinforce the key points.
4. Spatial Contiguity Principle	"People learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen."	Regular use of on-screen annotations allowed words and pictures to be presented close to each other.
5. Temporal Contiguity Principle	People learn better when corresponding words and pictures are presented simultaneously rather than successively.	The narrated format of the digital lecture meant that words and pictures were presented simultaneously.

Table 1: The use of five principles for reducing extraneous processing in designing digital lectures

Name of the principle	A Summary of the principle (Mayer 2009, p.268)	Impact on the design of the twelve digital lectures
6. Segmenting Principle	"People learn better when a multimedia lesson is presented in user-paced segments rather than as a continuous unit."	The twelve digital lectures formed part of a cognate sequence, and each lecture was structured into approximately seven parts (i.e., seven computer files). Students could choose which part of the lecture they viewed. They also had the ability to stop, pause and rewind the coverage.
7. Pre-training Principle	"People learn better from a multimedia lesson when they know the names and characteristics of the key concepts."	Coverage of the key concepts formed a central part of each lecture. Students who watched the digital lectures were completing a finance major in the Bachelor of Business and had already covered finance units.
8. Modality Principle	"People learn better from graphics and narration than from animation and on-screen text."	All of the digital lectures were narrated. On screen text and animation were not used.

Table 2: The use of three principles for managing essential processing in designing digital lectures

Name of the principle	**A Summary of the principle (Mayer 2009, p.268)**	**Impact on the design of the twelve digital lectures**
9. Multimedia Principle	"People learn better from words and pictures rather than from words alone."	The digital lectures involved the use of words and pictures.
10. Personalisation Principle	"People learn better from multimedia lessons when words are in conversational style rather than formal style."	The narration was in a conversational style which involved the lecturer/narrator talking directly to the student. This was possible because the digital lectures were recorded at the desktop for that purpose, rather than in a lecture theatre as a recording of an actual lecture.
11. Voice Principal	"People learn better from when narration in multimedia lessons is spoken in a friendly human voice rather than a machine voice."	A machine voice was not used in these digital lectures.
12 Image Principal	"People do not necessarily learn better from a multimedia lesson when the speaker's image is added to the screen."	Most lectures were structured into approximately seven parts. The appearance of the speaker's image on the screen only occurred briefly in the first and last parts of each lecture. This image was used to establish a social presence for the speaker in the student's mind.

Table 3: The use of four principles for fostering generative processing in designing digital lectures

Name of the boundary condition	**A Summary of the boundary condition (Mayer 2009, p.269)**	**Possible impact on the twelve digital lectures**
Individual Differences Condition	"Design effects are stronger for low-knowledge learners than for high knowledge learners."	Students watching these digital lectures were undertaking a structured course of study in finance. The unit which incorporated the digital lectures obviously contained new finance content for the students. For that reason, they could be regarded as low-knowledge learners; and multimedia design effects were potentially stronger for them.
Complexity And Pacing Conditions	"Design effects are stronger for multimedia lessons with high-complexity content rather than low-complexity content, and fast-paced presentations rather than slow-paced presentations."	The finance content in these lectures is generally regarded by students as being of a high-complexity due to complexity of the concepts as well as the graphical and mathematical content in the exposition.

Table 4: The impact of two boundary conditions on the design of digital lectures

Other Types of Digital Lectures

As previously described, the type of digital lecture used in this research involved desktop recording of on-screen activity (viz., PowerPoint slides, Excel spreadsheets, Word documents, websites, and scanned images) with the addition of narration and on-screen annotations. Desktop recording allowed some control over the quality of the recorded material by the use of a pause button or through the ability to re-record particular segments. A number of other alternative formats for a digital lectures are possible and two of the obvious ones are commented on here.

One possible format is an audio stream of a lecture, either of the actual face-to-face lecture or recorded at some other time. Typically, this type of digital lecture would be provided to students as an MP3 file. One obvious point to make about this format is that it is not a multimedia format, since there are spoken words and no pictures. Such a format would not employ Mayer's cognitive theory of multimedia learning which states that meaningful learning can be enhanced by presenting information in both visual and auditory formats.

A second possible format for a digital lecture is as a recording of a live lecture. From a purely logistical perspective, it is likely to be more difficult to control the quality of the recorded material in a live setting. For example, the audio quality of the lecturer can vary and sometimes it can be difficult to hear any questions asked by the audience. Also problematic can be what appears on the screen. Certainly, it is difficult in a live recording of a face-to-face lecture to duplicate the quality of images that can appear in a desktop recording where there is ready access to a variety of different types of software, plus the opportunity to pan, zoom and annotate to areas of interest. An additional problem with recording a live lecture is that the viewer tends to be an observer of a lecture rather than a viewer involved in a conversation.

A Framework for Explaining the Student Learning Benefit from Digital Lectures

The following framework has been developed to explain the potential learning benefit to students from having access to digital lectures in addition to face-to-face lectures.

Access

The face-to-face lecture typically involves a once-off delivery of the lecture content. One way a digital lecture might improve student learning is by providing the student with a way of accessing that content after the face-to-face lecture is completed. This could improve student learning in a situation where the student did not attend the face-to-face lecture (for a variety of possible reasons). It could also improve student learning in a situation where the student attended the face-to-face lecture but did not understand all parts of the content. Even in those situations where the student has attended the face-to-face lecture and understood all the content, there is the possibility that this understanding might dim with time. The digital lecture offers the possibility for a student to refresh their understanding at some later stage. This could be important in situations where the content is required, for instance, to work on an assignment or revise for a final exam.

Control

Delivery of content in a face-to-face lecture is typically done in a place and at a time that is determined by the university and at a pace that is largely determined by the lecturer. Students may ask questions or points of clarification, but generally these "interruptions" are limited by the lecturer's desire to cover the required content in the time available. Digital lectures may have learning value to students through providing them with some control over the delivery of the lecture content in those place and time dimensions. In terms of the place dimension, the digital lecture provides the student with ability to decide where they will watch the lecture content. It is likely that the choice of place will be influenced by what is best for learning. The time dimension potentially has two aspects to it. The first relates to the time of day that the student watches the digital lecture. Like the choice of place, there are likely to be certain times of the day that are better for the student to learn. The other aspect to the time dimension relates to the controls included within a digital lecture in the form of play, pause, stop, rewind and shuttle buttons. Given that a student has chosen a place and a time to watch a digital lecture, these buttons allow control over the delivery of the content so as to fit the particular learning needs of the student at that time.

Learning

In addition to allowing control over time and place, digital lectures may have learning benefit to students, relative to face-to-face lectures, through the way that they present the lecture content. For example, students may find it easier to understand what a lecturer is saying and displaying in a digital lecture due to the clarity of both the audio and the images on the screen. Students may also gain a learning benefit from digital lectures through the way that they have been designed. The use of narration in a conversational style, and the use of annotations to direct the student's attention are some examples of how the multimedia design principles detailed by Mayer (2009) have been used in the development of these digital lectures.

Research Design

Student Body

Fifty students were enrolled in the unit and 40 participated in the survey. Of the 40 participants, 21 were international students with 13 of them from a non-English speaking background. Seventy five percent of the participants were aged between 20 and 25 years.

Syllabus

The students who participated in the research were enrolled in a third year finance unit of study which was one of 24 units in an undergraduate business degree. The subject matter of the unit was the management of financial institutions. Broadly, the focus was on the management of the major balance sheet risks (i.e., capital risk, liquidity risk, credit risk and interest rate risk) and the risk-return trade-off decisions inherent in that management.

Lecture Timing

The lecture was scheduled from 6.30-8.30pm on a Tuesday, with the tutorial running prior to the lecture at 5.30-6.30pm. Mention is made here of lecture timing, because anecdotally, the evening lecture time was not liked by some students. In particular, those without their own transport said that they did not feel comfortable travelling on public transport after the lecture had finished. This had the potential to influence their decision to view a digital lecture over attending a face-to-face lecture. There was also another group of students who worked during the day and said that they found it difficult to maintain concentration in the evening lecture.

Assessment

Another factor that had the potential to influence student use of digital lectures was the unit assessment. It was comprised of an assignment of 50% and a final exam of 50%. The assignment involved a comparison of risks for two banks listed on the Australian Stock Exchange. This assignment was in five parts which had submission deadlines in Weeks 5, 7, 9, 11, and 13 and weightings of 5%, 10%, 10%, 10% and 15% respectively. In previous semesters, the assignment had been structured as one major piece of work for submission in Week 13. With the move to a five part progressive structure (in response to student feedback), students may have been inclined to make more regular use of the digital lectures throughout the semester, rather than mainly using them at the end of the semester.

Access to Face-to-Face Lectures and Digital Lectures

The semester unit was run over 12 weeks. Students were free to choose which face-to-face lectures they attended and which digital lectures they viewed. Each digital lecture became available on the course management system at the same time that the face-to-face lecture commenced. Alternatively, students could collect the digital lecture on a CD just prior to the face-to-face lecture commencing (or at some other time); or arrange to have it posted out.

Logistics of the Survey

Students were invited to express an interest to participate in the survey in Week 5 of the semester. The survey was run after the semester was finished. Significantly, this meant that students' final grades had been submitted to the university administration prior to the survey being conducted. The survey was structured in an Excel worksheet and distributed to students by email. Forty two of the 43 survey questions had responses that were accessed via pull-down menus attached to the relevant cell. The one exception was the final open-ended question. Trials of the survey indicated that it took around 12 minutes to complete.

Coordinating the distribution and receipt of the survey was an independent person who checked that all identifying information was removed from survey responses. In turn, she forwarded the final collated spreadsheet of survey responses to the Associate Dean, Research & Higher Degrees, who also checked that no

identifying information had been included. Survey responses were then forwarded on to the researchers. Students were advised that this structure had been put in place so as to facilitate them providing open and honest feedback on the digital lectures.

Structure of the Survey Instrument

The survey instrument was comprised of 43 questions which were organised under the following seven headings:

- Your background
- How much have you used the face-to-face lectures and the digital lectures?
- Which platform did you use to watch the digital lectures?
- How much did you use the digital lectures in revising for the final exams?
- How much did you use the digital lectures in preparing for the assignment?
- Learning benefits
- Improving the digital lectures
- A final open-ended question

The section on educational benefits involved 15 questions which were structured as positive statements. Students were asked to indicate whether they strongly disagreed, disagreed, were neutral, agreed or strongly agreed with each statement. Responses were quantified on a 5 point Likert scale and mean responses were calculated for each question.

Other Data

Two other sources of data were available to validate survey responses. The first was the university unit and teaching evaluation survey of students conducted by the university in week 12 of the semester. While this survey did not contain any direct questions about digital lectures, it did give students the opportunity, in a final open-ended question, to comment about the unit, lecturer or tutor. A number of students took that opportunity to comment on the digital lectures. These comments are analysed in the results section.

The second source of data was collected by the lecturer each week. It detailed student lecture attendance and CD collection. This data is used in the results section as a cross-check on reported lecture attendance in the survey.

Results

The discussion of the results follows the structure of the survey.

Background of the Student Survey Group

The group was an approximately equal mix of males and females, international and domestic students, and English-speaking and non-English speaking backgrounds. Seventy five percent of the group was aged between 20 and 25 years. Eighty percent of the group were studying either 3 or 4 units, where 3 units is a typical full-time load for an international student and 4 units is a full-time load for

most domestic students. Just over half the group were employed between 11 and 30 hours per week.

Use of Face-to-Face Lectures and Digital Lectures

On average, students reported attending 9 face-to-face lectures and watching 9 digital lectures. These figures are approximately consistent with records of lecture attendance and CD collection kept by the lecturer for Weeks 4 – 12 and presented graphically in Figures 2 and 3. Weeks 1 -3, which typically have the highest level of attendance are not included in the graph. This might explain the slight discrepancy between the reported attendance of 9 lectures (i.e., 75%) and the observed attendance of 8 lectures (67%). Only 12.5% of students described themselves as light users of the digital lectures over the semester. Almost 40 percent of students described themselves as heavy or very heavy users. Overall, the digital lectures were widely used. As many lectures were watched digitally as were watched face-to-face.

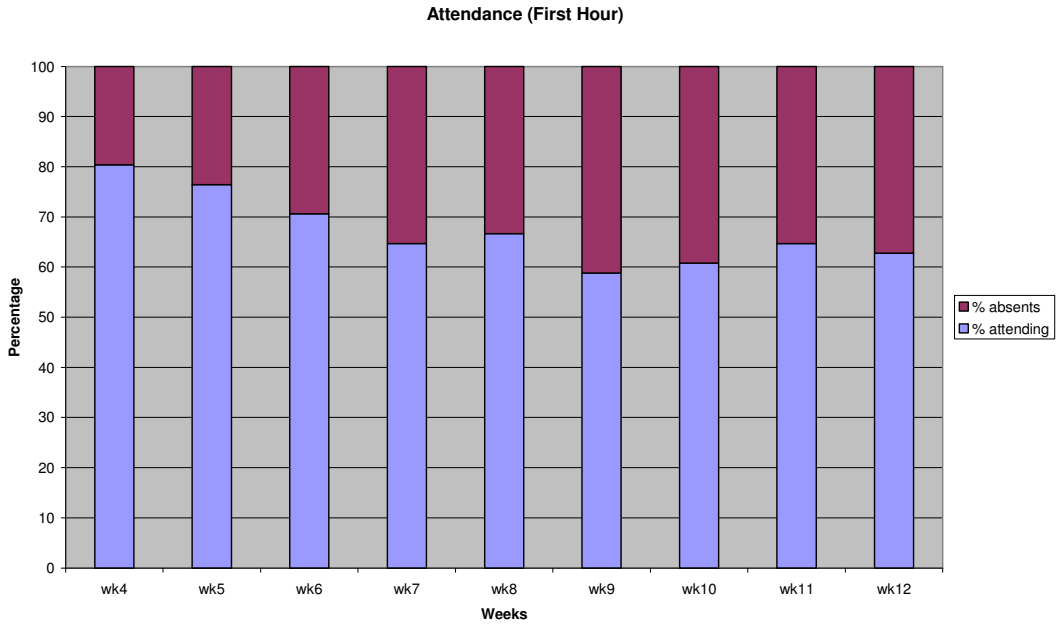

Figure 2: Lecture attendance in weeks 4 – 12

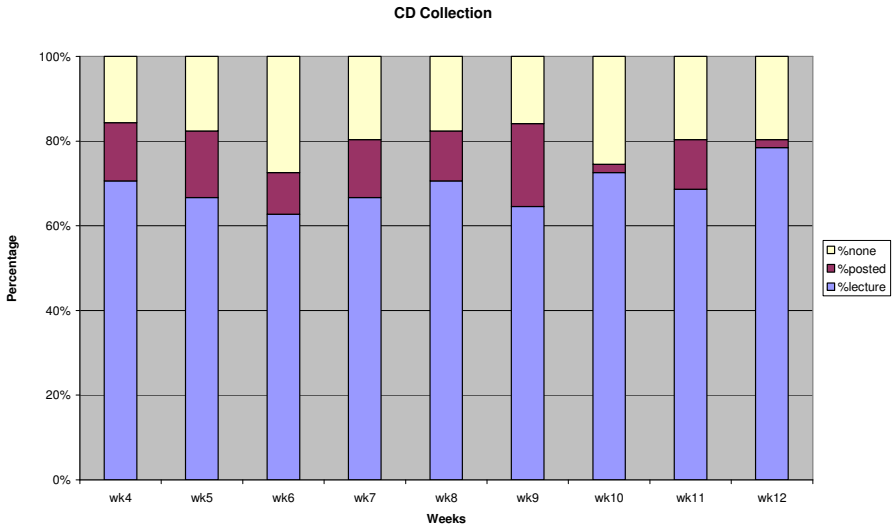

Figure 3: CD collection in weeks 4 - 12

Platform used to watch digital lectures

The figures on the platform and venue used to watch the digital lectures show that the two thirds of students watched the digital lectures from a CD, while three quarters of students watched the digital lectures at home. These figures have been cross-tabulated in Table 2. What the figures show is the popularity (60%) of watching the digital lectures on CD at home. When asked later in the survey, all 23 of these students strongly agreed with the statement that "digital lectures gave me the flexibility to watch a lecture at a time and place of my own choosing, and this assisted my learning in the unit" (Q24, mean value = 4.69).

Informal comments made by students during the semester suggest that there are a number of related reasons why so many of them watch the digital lectures from a CD at home. Many said that they either did not have internet access at home or that they didn't have broadband, which is the standard of access necessary for watching a digital lecture on-line. Others commented that a CD was much more reliable of watching a digital lecture than their internet connection. These comments are in contrast to the findings of Caruso and Kvavik (2005), who found that virtually all US students had access to the internet and the majority had broadband access.

	CD	On-line	TOTAL
Home	23	5	28
Campus	1	7	8
Work	0	1	1
Other	0	1	1
TOTAL	24	14	38

Table 2: Platform and venue used to watch digital lectures

Use of Digital Lectures in Revising for the Final Exam

In revising for the final exam, students watched an average of 7 digital lectures. Twenty percent of students revised by watching the whole lecture. The rest

watched selected parts or a mix of selected parts and the whole lecture. Students reported that for each lecture they watched, they took 2 breaks and replayed 2 to 3 parts of the lecture.

Use of digital lectures in preparing for the assignment

The assignment was in 5 parts. On average, students prepared for 3 to 4 parts of the assignment by watching the relevant digital lecture(s). One third of students watched the whole lecture as part of their preparation, while the rest watched selected parts or a mix of selected parts and the whole lecture. Students reported that for each lecture they watched, they took 1 to 2 breaks, replayed 2 parts of the lecture and watched the whole lecture once.

Learning benefits from the digital lectures

Questions 23 to 37 consisted of a series of statements about the digital lectures and the face-to-face lectures. Students were asked to choose their response to each statement from the alternatives "strongly disagree", "disagree", "neutral", "agree", or "strongly agree". Responses were coded on a five-point Likert scale where strongly agree had a value of 5. A mean value was calculated for each question.

Face-to-face lectures

Overall, students were satisfied with the quality of the face-to-face lectures (Q34, mean value = 4.31), with local students more satisfied (4.56) than international students (4.10). In a week 12 survey conducted independently by the university, students were asked to respond to the statement "I was satisfied with the performance of the lecturer". The mean response of 4.54 is comparable with the mean value of 4.31 obtained for Question 34.

Students valued the opportunity to interact with the lecturer by asking questions and listening to answers (Q32, 3.97) and they liked the routine of a regular weekly timeslot for the lecture (Q33, 3.84). Local students were neutral to the proposition that it was easier to understand what the lecturer was saying in the digital lectures compared to the face-to-face lectures (Q30, 3.06). However, international students agreed with this statement (Q30, 3.90). This difference might explain the previously noted difference in overall satisfaction with face-to-face lectures between international and domestic students.

Improved access from digital lectures

Students strongly agreed with the statement that their learning was assisted by having access to a digital lecture in those weeks where they could not attend the face-to-face lecture (Q25, 4.69). They also agreed that it would have been inconvenient for the digital lectures to have only been available on the course management system and not on CD (Q26, 3.77). This level of agreement reflects the countervailing influences of two-thirds of students who watched the digital lectures from a CD at home and

strongly agreed or agreed with the statement and the other one-third who watched the digital lectures on-line and gave a mix of "neutral" and "disagree" responses.

Improved control from digital lectures

The ability of a digital lecture to provide the student with control over the time of viewing the lecture content was highly valued in terms of assisting learning (Q24, 4.69). Students were also very positive (Q29, 4.74) about the learning benefits of being able to pause and rewind the digital lecture. They also valued the ability to stop the digital lecture when their concentration waned (Q31, 4.39).

Improved learning from digital lectures

Apart from the benefits offered by digital lectures in terms of control over place and time, students also agreed that the design of the digital lectures improved their learning. For example, they strongly agreed that the drawing pencil helped them follow the lecturer's explanation (Q27, 4.74). They also strongly agreed that the various resources in the digital lectures (such as Excel spreadsheets, websites, etc.) assisted their learning (Q28, 4.69). Lastly, and this has been mentioned in a previous section, the international students felt that it was easier for them to understand what the lecturer was saying in the digital lecture compared to the face-to-face lecture (Q30, 3.90) whereas the local students were neutral to that proposition (Q30, 3.05).

Overall views about digital lectures

In overall terms, students strongly agreed that access to digital lectures had improved their learning in the unit (Q37, 4.56). This can be considered against a background of students being satisfied with the face-to-face lectures. So the overall satisfaction with the digital lectures was not a relative reflection of the digital lectures being compared with poor quality face-to-face lectures. From responses to other statements, it would appear that the digital lectures created access, control and learning benefits that the students' valued highly. As for the use of digital lectures in other units in their degree, students felt strongly that this would have improved their learning in these units (Q36, 4.74).

The final question in the survey was open-ended and invited students to comment on aspects of the digital lectures which they may not have liked or aspects which they saw as valuable. Out of a total of 40 respondents, 27 students made comments. Despite being invited to make negative comments about the digital lectures, only five of the 27 commenting students did so. The consistent themes in these five comments were that:

- The 12 digital lectures were too long to watch as preparation for the final exam and that a shorter summary digital lecture would have been more useful;
- The lecturer tended to waffle a bit at times, saying some things that didn't need to be said; and
- The screen annotations were, at times, superfluous.

Twenty three students made strongly positive comments about the digital lectures. Some of the consistent themes in these comments were that:

- Face-to-face lectures were still seen as being centrally important for student learning, but combining them with digital lectures was a "win-win" situation (as one student described it);
- Digital lectures were excellent to have in preparing for the tutorial questions, each assignment part, and the final exam;
- For other students, digital lectures were not used in preparing for the final exam as these students had already watched them in preparing for the parts of the assignment and had developed a good grasp of the content; and
- Digital lectures were also very useful to have to backup the face-to-face lecture coverage for situations where attention was waning at the end of the day or a lecture was missed.

Other corroborating sources of information

In week 12 of the semester, the university conducted an independently administered unit and teaching evaluation survey. No specific questions about digital lectures were included in this survey. There were, however, two open-ended questions: "what were the best aspects of this unit" and "what aspects of this lecturer's approach to teaching best helped your learning". Digital lectures were mentioned positively by 20 students out of a survey group of 60. Fourteen identified digital lectures as one of the best aspects of the unit while nine mentioned digital lectures as part of the lecturer's approach which best helped their learning. Ordinarily, students complete this survey without making any open-ended comments about the unit or the lecturer. To have such a large number of unsolicited positive comments about the digital lectures could be taken as an independent corroboration of the very positive comments made about digital lectures in the survey conducted as part of this research.

Conclusions and Further Research

Based on this early research, it appears that digital lectures can be a resource that students will use and gain learning benefit from. The students in this study viewed as many digital lectures as they attended face-to-face lectures. They made particularly heavy use of the digital lectures in preparing for parts of the assignment, in revising for the final exam, and in catching up on face-to-face lectures that they had missed. What the digital lecture format seemed to offer these student was a learning benefit based on better access, control and learning of the lecture content. International students, in particular, seem to be better able to follow what the lecturer said in the digital lecture format. Despite the benefits from the digital lectures, it appears that students prefer to use them in combination with face-to-face lectures. For this reason, it seems more likely that digital lectures could form part of an evolution rather than a revolution of teaching and learning.

There are a number of possibilities for further research. A logical next step would be to see if the results could be duplicated for other groups of students and other units of study. International students would be a group to focus on in further research. There is a suggestion that their language difficulties might be lessened in a digital lecture format. Further research could explore this important issue. Attrition rates amongst first year students, in particular, are typically high. Could the use of

digital lectures in first year units reduce these attrition rates? One informal observation of the lecturer coordinating the Financial Institutions Management unit, which was the subject of this research, was that student consultations seemed to be reduced. It seemed that students got answers to many of their questions through watching the digital lectures rather than asking the lecturer directly. Further research could try and establish if this was the case.

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