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THE IMPACT OF ON-LINE LECTURE RECORDINGS ON STUDENT PERFORMANCE

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DISCUSSION PAPER 11.09

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ABSTRACT

The use of online lecture recordings as a supplement to physical lectures is an increasingly popular tool at many universities. As its popularity grows, however, there is increasing evidence that some students are using these recordings as a substitute to attending the actual lectures, rather than as a complement that helps them revisit difficult content, or for study purposes. Does this trend matter? If students receive as much (if not more) benefit from viewing their lectures online as they do by attending in person, then this is surely the student's right. However, this has potentially significant consequences for the delivery of lecture content in higher education. This paper combines survey data with student record data for students in a first year Microeconomics class to examine this issue. The main finding is that, whilst there are indeed some students using online lecture recordings as a substitute to attending lectures, they are ultimately at a fairly severe disadvantage in terms of their final marks. Controlling for a wide variety of student characteristics, we find that, relative to attending zero to six lectures (out of 26), those attending essentially all lectures in person (25 or 26 lectures) have a direct advantage of nearly eight marks. Moreover, students attending zero to six lectures do not close this gap by viewing more lectures online, despite having double the number of lecture recording hits as their colleagues who attended 25-26 lectures. In contrast to this, students who attend the majority of lectures in person *do* receive a benefit from additional use of the lecture recordings. The results provide evidence that, when used as a complementary tool, lecture recordings are a valuable supplement for students. However, when used as a substitute, lecture recordings provide no additional benefit.

1. Introduction

The use of web-based learning technologies at universities has increased significantly over the past few years. This is particularly true of audio and/or visual recordings of face-to-face lectures, which are streamed via the web for students to view or download. Although there have been few empirical studies on this issue, at a theoretical level there have been a number of arguments put forward on the perceived costs and benefits to both students and staff of lecture recordings. With respect to the perceived benefits, the two most commonly-cited are that lecture recordings are a valuable complementary learning tool for students, allowing them to either revisit content they struggled with during the physical lecture, or as a study tool before examinations. Moreover, these recordings allow students to pause, rewind, or skip through sections of the lecture as they see fit (Bennett and Maniar, 2007). In other words, having these recordings as an additional resource for students allows both flexibility for the student, as well as another beneficial study tool. The second perceived benefit is that lecture recordings provide a better 'fit' for the current generation of students (Skene et al, 2007), in terms of their extensive familiarity with web-based content, as well as their desire to have '24/7' access to course material. This may be particularly important for students who, whether by choice or necessity, are engaged in paid employment whilst concurrently studying for their degree.

The empirical evaluation of these perceived benefits have been somewhat mixed, and are often focussed on slightly different scenarios. For example, Day and Foley (2006) ran a quasi-experiment, with half of one class attending traditional face-to-face lectures, whilst the other half used lecture recordings (along with other web-based learning materials). They found that the students using the lecture recordings performed better in their final grades than those students who were only attending lectures. Chiu et al (2006), using a similar methodology, noted a similar result. However, Figlio et al (2010) found a modest, though significant, positive effect on grades for those students in their experiment who attended the 'live' lectures, as opposed to those who were only allowed access to the lecture recordings. Others again (Brotherton and Abowd 2004; Bell, Cockburn, McKenzie and Vargo 2001) found no statistically significant difference in the grades obtained by the online versus face-to-face groups of students. Many of these empirical papers have tried to use a controlled experiment to tease out the efficacy of these two forms of delivery by separating students into two groups. The reality, of course, is that on-campus, these online recordings are largely used as an *additional* tool, and not as a substitute delivery option.

What of the perceived negative effects of using web-based lecture recordings? Bennett and Maniar (2007) note two major issues with lecture recordings: (1) they make learning uninteresting, because the student loses the immediacy of the lecture, and the enthusiasm of the lecturer may not translate to the recording; (2) students may not develop as independent learners, as the recorded lecture content takes on a level of importance it probably should not have. A number of Australian studies have incorporated the qualitative

comments of students (for example, Larkin, 2010, Skene et al, 2007 and others), and a common refrain has been that lecture recordings decrease lecture attendance, thereby diminishing the 'atmosphere' of a lecture, and decreasing the degree of interaction during the lecture. However, although these qualitative papers provide some important insights to the role of lecture recordings, there are very few that have attempted to assess this impact in a quantitative manner. Of interest to us here is whether students who use lecture recordings extensively perform on average better or worse in terms of their final grade than students who predominantly come to face-to-face lectures, and what the interaction between the two modes of delivery might be. In order to examine this issue, a survey of students was conducted, which was then married to student data we gathered on the use of lecture recordings and other web-based learning materials. Section 2 gives some details on the survey conducted. Section 3 looks at some summary statistics and briefly discusses the issue of whether lectures and their recordings are substitutes or complements, as well as some survey results on *why* students are using lecture recordings. In Section 4, we apply a formal regression analysis to the data, and discuss the results. Section 5 has some concluding comments.

2. Outline of survey

The survey was conducted at the University of Western Australia, in classes for the first year Microeconomics principles class, during the final week of Semester 1 of 2010. Gathering the data during tutorials rather than lectures ensured that data on lecture attendance (see below) was not biased by only including students who were physically attending the lectures. Of the 859 students who ultimately received a mark for this unit in Semester 1, we were able to get complete data for 387 of them, which appears to represent a reasonable sample across the grades (see Chart 1). The biggest difference from Chart 1 is that the students who ultimately failed this unit are under-represented in the sample (15.7% failed overall, while just under 10% of students in this sample failed). This is probably to be expected however, due to the fact that many who fail this unit ceased to be active participants well before the semester finished, but who had not formally withdrawn. Hence they were probably not in the final week's tutorial. Therefore, we are reassured that this sample is representative of the overall body of students who were actively involved in this unit.

The survey itself covered a range of issues that can loosely be put under the heading of the first year 'experience'. Students were asked a number of questions relating to different aspects of their university experience, including questions on: (i) their characteristics (gender, birthplace, age, whether living at university colleges, or with parents, and so on); (ii) education information (prior education, including whether they had studied economics before, as well as information on parents' education levels); (iii) Employment Information (whether they engaged in paid employment, how many hours per week, and their opinion

on whether it helped or hindered their study); (iv) Social networking (whether they belonged to university clubs, time spent at these clubs, as well as information on whether they had made friends since starting university); (v) Experiences at university (a series of questions on their degree of satisfaction with their university life, what their biggest problems were in the transition from high school and so on); (vi) Study habits (including hours per week of study, how many face-to-face lectures they attended, plus several questions on their use of lecture recordings).

For the purposes of this paper, it is this last category that we were most interested in. Students reported the number of lectures they attended (out of 26), whether they used the online recordings, and the reason they used them.[2]

3. Some initial results from survey

We were also able to pull out data on the number of hits on lecture recordings for most students.[3] Overall, these recordings have been used extensively by many students. Over the course of the semester (from Week 1 until the final exam), students accessed these recordings over 33,000 times. As Chart 2 shows, usage tended to be clustered around the end of the semester, particularly during the study break, and into the week of the exam.[4]

In terms of individual usage of the recordings, the average number of hits across the 387 students who we ultimately had complete data for was 33 hits, with the minimum being 1 and the maximum 119.[5] With respect to lecture attendance, Table 1 shows that, on

[2] There is a potential problem here in that students were self-reporting the number of lectures they attended. Although we cannot guarantee students were being truthful, we also asked them a number of questions that were verifiable from other sources. For example, they were asked to report their university entrance score, which we then compared to this data from their Student Records. Any student whose answer was more than 5 percentile points off their actual score was subsequently omitted from the analysis. Whilst they also self-reported some general information on the lecture recordings, in the empirical analysis below we used actual data taken from the Lectopia website.

[3] UWA uses the *Lectopia* online lecture recording system, which is now used extensively, both in Australia and increasingly overseas. This system uses both audio and visual, with the visual element being generally video capture of the Powerpoint slides, or a visualiser. In data collected from this system, around 16% of total hits were not able to be attributed to an individual student. As a result, 55 students who participated in the survey have no record of *Lectopia* hits. This does not mean that they did not access *Lectopia*, merely that the system did not recognise them. It's not clear why this would be so.

[4] This is in part due to the fact that the lecturer also recorded 10 sample exam questions, with model answers, using desktop capture software. These sample exam questions, released at the end of the last week of semester, accounted for 6,000 of the 9,000 hits for the final two weeks (study break plus the week of the exam).

[5] This does not include outliers we removed from the sample. The highest number of hit across all observations was 188. It strikes us as unlikely any student would view the 26 lectures and 10 short answer questions 188 times in their entirety, however, in the absence of data pinpointing the length

average, students attended around 72% of lectures (18.75 out of 26), with students reporting across the entire range of attendance from none, through to 26.[6]

3.1 Are lectures and online recordings substitutes, or complements?

As seen in Chart 3 below, which shows the average number of online recording hits by the number of lectures attended, the answer appears to be that students who are not attending lectures are at least (on average) viewing them online. For example, students only attending 0-6 lectures out of 26 have an average number of hits that is double the number of those attending either 22-24 or 25-26 lectures. In other words, at least some students appear to be using the online recordings often as a substitute for lectures (the pair-wise correlation between them is -0.26). The more pressing question, however, is whether the lecture recordings and face-to-face lectures are *perfect* substitutes – do students viewing fewer lecture recordings, but attending more lectures in person, ultimately receive the same final mark , *ceteris paribus*, as students who use lecture recordings extensively, but do not attend many face-to-face lectures? This is a question we will attempt to answer in a later section. However, before we do this, we want to take a brief detour into the *motivation* behind the use of these lecture recordings.

3.2 Reasons for using lecture recordings:

Although we have data on the number of lectures attended, plus the number of lecture recording hits, we also wanted to know <u>why</u> students were using the lecture recordings. For example, are there aspects common to students who rarely (if ever) attended lectures in person? To that end, one of the questions in the survey asked students the primary reason they used the lecture recordings. Because it is the link between the physical and online lectures that we are interested in, we broke the results down by lecture grouping. The results are presented in Table 2 below.

Overall, half the students responding to this question from our sample (366 students) said that they used the recordings to either revisit content they found difficult in lectures, or as a study tool. However, if we break this into lecture attendance groups, we can see some differences emerging. Unsurprisingly, not one person in the 0-6 lecture category used it to revisit content (given that there was little for them to 're' visit). However, they did not use it much for study purposes either. By far the biggest category for these students was that they used the lecture recordings because they 'preferred them to face-to-face' (43% of all students attending 0-6 lectures). Despite this (non) preference being a significant minority,

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of time spent viewing these files, the quantity of 'hits' is the best we can do. Furthermore, we are essentially assuming here that 'hits' equates with 'effective use' in the subsequent analysis, however, we have no information on the efficacy of students' use of these recordings. In the absence of how the students are using the recordings, we will assume that more hits equals greater use.

[6] There were two 45 minute lectures per week over a 13 week semester.

there is also an element of compunction for some of these students. Collectively, nearly one-third of students in this category used the recordings due to work commitments, or a timetable clash. Therefore, even if they wanted to attend lectures in person, circumstances were preventing them from doing so.

What about those students who were attending the vast majority of lectures? As one would expect, they were using the lecture recordings to revisit content (42%), for study (17%), or to catch up on the couple of lectures they missed out on (12%). These results, coupled with Chart 3 above, highlight the fact that there is something of a disjoint in the use of lecture recordings between those attending few lectures, who use it either because they don't like going to the lectures, or because they have to, and those attending most of the lectures, who are just using the recordings for study, or to revisit content they didn't understand during the initial lecture. This is what is probably accounting for the large differences in the average number of recording 'hits' between the groups, as this latter group may only be using the recordings when and if needed, whereas for those not attending lectures it is more of a necessity. The question that remains, however, is whether these additional recordings viewed by students who are not attending the face-to-face lectures actually make up for these lectures they are not attending.

4. Regression analysis

The majority of studies that estimate the determinants of academic performance (for example, Anderson, Benjamin and Fuss, 1994, Dobson and Skuja, 2005 and Birch and Miller, 2007) are based on an education production function. In this model, a student's tertiary academic performance (Ap_i) is a function of a variety of student characteristics. In this analysis, we control for a large number of these characteristics: their prior academic achievements (Edu_i); their personal characteristics (Pc_i); characteristics of the secondary school attended (Ss_i); whether they are repeating the unit (Rp_i); a dummy for whether the student engaged in paid employment (W_i), plus an interaction term of this employment dummy multiplied by the number of hours of paid employment per week (HW_i); whether they did certain selected subjects in high school (Economics, Discrete Mathematics, English Literature, and/or Physics) (Pk_i); and their use of (voluntary) online quizzes, which here is used as a proxy for effort (E_i).[7] Finally, we include our two main variables of interest: the

[7] These multiple choice quizzes were completely voluntary, could be attempted any number of times, and did not count towards their final grade. We believe in this instance that these quizzes represent a better proxy for effort than, say, tutorial attendance, because tutorial attendance was worth 10% of the final grade, and hence there's an inherent bias in attendance. Because this variable has a number of 'zeros', we have divided the quiz variable into dummy categories (0-1 quizzes attempted, 2-10 quizzes, 11-15 quizzes, 16-20 quizzes, 21-25 quizzes, and 26 and over quizzes).

number of online recording 'hits' during the semester (LR_i), and the number of lectures attended (LEC_i).[8]

$$Ap_i = F\left(Edu_i, Pc_i, Ss_i, Rpi, W_i, HW_i, Pk_i, E_i, LEC_i, LR_i\right). \quad (1)$$

It is common for studies to measure students' academic performance by their final grade for their unit of study (usually measured as a mark out of one hundred) and estimate the production function using Ordinary Least Squares (OLS). This procedure allows for the determinants of academic performance to be examined at the conditional mean of university marks, and is the approach we take here.[9]

Table 3 has some summary statistics on each of the variables employed, as well as information on the omitted variables for the various dummy variables employed. Column 1 of Table 4 includes all of our control variables, but excludes the lecture recording and lecture attendance variables. Many findings of the models to estimate the determinants of academic performance are similar to those presented in the existing literature (see Birch and Miller, 2004 for a review of studies). For example, the students' TER has a positive and highly significant effect on student performance. Every 1 percentile increase in a student's rank translates on average to a higher final mark of 0.78 percentage points. Of the TEE subjects studied, prior knowledge of Economics and English Literature resulted in a final mark that was 4.2 and 3 marks respectively higher than those who have not studied these subjects at High School.[10] Students who took Discrete Mathematics, however, have a significantly lower mark than those who did not study Discrete Mathematics (by 6.7 marks).[11] In terms of students' previous schooling, attendance at either an independent or Catholic school had a negative effect on student performance, relative to those attending a government school, of around 4 marks. This is similar to previous research, such as Birch and Miller (2007).

Perhaps the most notable result in this initial regression relates to the voluntary quizzes attempted by students. Relative to students who attempted more than 25 quizzes, students who only attempted between 0 and 10 quizzes had marks that were, on average, over 10 marks less. Given that there were only 10 separate quizzes put up for students to use, this

[8] Again, because a number of students did not attend any lectures, we can't treat this as a continuous variable, and so we have divided it into dummy variable categories (0-6, 7-13, 14-18, 19-21, 22-24, and 25-26, as above).

[9] We also ran these regressions using an ordered probit model, however, the results were quantitatively very similar, and so have not been included here. Results available on request.

[10] This is in line with previous research on the benefit of prior knowledge of Economics (see for example, Birch and Williams, 2010).

[11] In Year 12, students in 2009 and earlier could take Discrete, Applicable, or Calculus Mathematics.

suggests that students who attempted these quizzes a multiple of times ultimately performed much better than those who only attempted each quiz once (or not at all).[12]

Turning now to Column 2, we introduce the lecture attendance dummies, and the lecture recording 'hits' variable.[13] With respect to the lecture attendance dummies, we see that students who attend more lectures have higher marks relative to those who only attend 0-6 lectures. This differential is most pronounced for students attending either 25 or 26 lectures (7.97 marks), but is also a statistically significant factor for all students who attend more than half of the lectures (that is 14 or more). Although students who attend between 7-13 lectures do have a positive marks differential with those only attending 0-6, this difference is not a statistically significant one. These differences, particularly for those attending nearly all of the lectures in person, are substantial, and equates to almost a whole grade.

With respect to the use of lecture recordings, we can see that the direct effect on student performance is positive, and also significant. According to this result, a one standard deviation increase in the use of these lecture recordings (roughly 25 hits) translates into an increase in final marks of 2 percentage points.

However, whilst the direct effects of both lecture attendance and lecture recordings on student performance are positive, and significant, this is not the question we really want answered. What is of interest here is, if lectures and lecture recordings are substitutes, whether they are equivalent substitutes. In order to answer this, we need to introduce the interaction between lectures and lecture recordings (Column 3).[14]

The estimating equation for the interaction terms can be written as (for the sake of brevity, the additional control variables have been excluded from the equation below):

$$Mark_i = a + b_1(LR_i) + b_2(LEC_{7-13}) + b_3(LEC_{14-18}) + b_4(LEC_{19-21}) + b_5(LEC_{22-24}) + b_6(LEC_{25-26}) + b_7(LR_i * LEC_{7-13}) + b_8(LR_i * LEC_{14-18}) + b_9(LR_i *$$

[12] We have included these quiz dummy variables as a proxy for effort, but we admit that it is impossible to tell from the available data whether these quizzes are simply proxying for effort, or whether there is a material gain in knowledge from doing these simple multiple choice quizzes a number of times. Whilst we still lean towards this variable being seen as an 'effort' variable, we admit that it might be the learning component of these quizzes that dominates.

[13] We have centred the lecture recording variable to have mean of zero, by subtracting the sample mean (33.3 hits) from each observation. The simple reason for this is to make the coefficients in the following analysis read more intuitively. When evaluating the interaction effects for example, each coefficient is interpreted relative to the lecture recording hits being zero. However, a more useful interpretation would be to ask what the effect is at the mean of the lecture recordings, not zero. Hence, by centring the mean at zero, we are really evaluating these coefficients on the mean.

[14] We also looked at other transformations, such as whether the lecture recordings were quadratic, or by taking the log of lectures. However, as these did not prove significant (either practically or statistically) these were not pursued.

$$LEC_{19-21}) + \qquad b_{10}(LR_i * LEC_{22-24}) + \ b_{11}(LR_i * LEC_{25-26}) + \ \ldots + \ e_i \qquad (3)$$

The addition of these interaction terms throws up some interesting results. Overall, we can see that the coefficients on each of the interaction terms (the coefficients $b_7 - b_{11}$) are positive – in each category of lecture attendance, higher lecture recording hits equated with better student performance. But this was only significantly different for two groups – those attending 25-26 lectures, and those attending 22-24 lectures. In other words, the students deriving the greatest benefit from the lecture recordings were the students who also went to the most lectures. Another way to look at the effect of lecture recordings, conditional on the lectures attended, is to graph the effect on final marks for each of these groups as the number of lecture recording hits increases.[15] Chart 4 summarises the effects for four lecture groups: 0-6 (our base category), 7-13, 22-24, and 25-26 lectures. The most striking aspect of this graph is the lack of impact that lecture recordings have on the group that is probably in most need of them – those who only attend 0-6 lectures. The slope here is essentially zero (-0.005), which means that for those students going to few lectures, no amount of lecture recordings will allow them to 'catch up' to those students attending most or all lectures.[16] Evaluated at the mean of lecture recordings, the benefit of attending 25-26 lectures is 7.73 marks over those attending only 0-6. However, a one standard deviation increase in lecture recording hits for both groups actually increases this differential to around 11.5 marks, and keeps getting wider as lecture recording hits increases beyond this.[17] Contrast this with those attending only marginally fewer lectures (22-24 lectures). Here, although there is a marks differential of around -2.5 marks compared to those going to 25-26 lectures, evaluated at the mean of lecture recordings (5.21 - 7.73= -2.52), the effect of lecture recordings is greater for this group, and so a one standard deviation increase in the lecture recording use for both groups reduces this differential to only 1.7 marks. In other words, provided you have gone to a significant majority of lectures, then greater use of the lecture recordings will help bridge the gap to your colleagues who have attended 25-26 lectures. For lower levels of lecture attendance, the effect of lecture recordings is greater than the

[15] Taking the 7-13 lecture group as an example, the calculation for the slope for this group is: $b_1 + b_7$ (-0.0054 + 0.1132 = 0.108), while the intercept at zero (i.e. the centred mean of lecture recordings) is given by b_2 (= 1.322). The slope for the base case (0-6 lectures) is simply the coefficient on the lecture recording variable (b_1 = -0.0054).

[16] As a test of sensitivity, we experimented with different lecture categories. However, they all qualitatively gave the same story, with the slope for the base category (the lowest category of lecture attendance) being at or around zero. For example, with the base category being 0-12 lectures, rather than 0-6, the coefficient on the lecture recording variable was marginally positive (0.011), but nowhere near statistically significant. Viewing the lecture recordings 100 times would still have resulted in a marks increase of less than 1 percentage point. The sizeable differentials between the lowest and higher categories remained.

[17] That is, 7.73 + [-0.0054+0.160]*25 = 11.6 for the 25-26 group, minus [-0.0054*25] = -0.135, which is 11.47.

base (0-6 lecture) case, which shows that significant improvements in final performance can be made with greater use of these recordings. However, in each group the slope is flatter than the slope for students attending 25-26 lectures, and so again the marks differential between these groups gets wider as lecture recordings increase.[18]

In Chart 3, we showed that lecture recordings hits were on average larger for those who attended fewer lectures. We can make use of this data to get a better idea of the effect of lectures and recordings on student performance we observe in practice. If evaluated at the group (not overall) means, we can see that, even though students attending 25-26 lectures only view the lecture recordings 24 times, versus 46 times for the 0-6 group, the marks differential is still 6.7. In other words, the additional lecture recordings that students in the 0-6 group do is nowhere near enough to counter the loss of marks from not attending the lectures in the first place. This differential does, however, get smaller for other groups. For example, students going to 19-21 lectures (which equates to missing around 2-3 weeks of lectures) did, on average, have quite a high number of lecture recordings (42.2). This reduced the differential between this group and those going to 25-26 lectures to less than two marks, whereas when we were just evaluating at the overall mean the differential was almost four marks.

5. Concluding comments

It should be remembered that these results come with a number of caveats. Probably the most important of these is that 'hits' does not necessarily equate with effective use. A student taking careful notes during a single recording is likely to get more benefit out of it than someone who restlessly moves between lecture recordings, Facebook, email, and so on, generating hits each time they go back to the recording. Unfortunately, this is not something we can measure. Secondly, the number of hits includes the period between the final lecture and the final exam and, as we saw in Chart 2, there was heavy use of these recordings over this period. A student may, for example, have accumulated most of their hits in these final two weeks, which has little to do with the ongoing use of these recordings during the course of the semester. Despite these caveats, however, we believe that these results are a useful step in providing some evidence-based analysis of the relative merits of attending lectures versus viewing them online.

The results obtained above demonstrate that, for first year Economics students at least, greater attendance at lectures has a positive and significant effect on ultimate performance. Moreover, this effect is fairly linear in nature – the more lectures you go to, the higher your

[18] As an example, take the differential between those attending 7-13 lectures versus those attending 25-26 lectures. At the mean, the differential of the 25-26 group over the 7-13 group is (7.73-1.32) = 6.41 marks. Increasing that to 1 st.dev above the mean (around 25 hits above the centred mean) leads to a differential of (11.61-4.02) = 7.59 marks.

eventual marks are.[19] As for lecture recordings, the effects are also positive, but conditional. If a student attempts to almost completely substitute face-to-face lectures with the online recordings, the news is not terrific – no matter how often they view the recordings, they never make up the lost marks from not attending the lectures in person. However, for those attending the majority of lectures face-to-face, then the lecture recordings do have a positive and significant effect on their performance. For example, those only missing a couple of lectures (22-24), whilst having lower marks than their colleagues who attended 25-26 lectures, can significantly reduce this differential by viewing more lectures online. For all other groups, though, this differential gets larger as recording hits increases. But this doesn't mean that the recordings are not useful at all. For students who are using the recordings largely to catch up on a relatively small number of missed lectures, and/or for revision purposes, they can be helpful. It's just that they appear not to be as useful as actually going to the lecture itself.

In very broad terms there appear to be two groups using lecture recordings: one, using them as a substitute for lectures, the other, as a complement. The evidence presented here strongly suggests that the lecture recordings are most useful as a complement to attending lectures, rather than as a substitute. As economists, we favour choice – if students want to receive lecture content via digital means rather than attending in person, they should be free to do so. However, if there is a demonstrable difference in outcomes in the two approaches, then students should at least be made aware of the consequences of the choices they are making.

[19] Of course, what this paper does not answer is why lecture attendance is such an important component of student performance. There are a number of plausible explanations, however, whilst this is an interesting course of future research, this goes beyond the scope of this paper.

Tables and Charts

CHART 1: GRADES FOR STUDENTS COMPLETING SURVEY VERSUS OVERALL GRADES

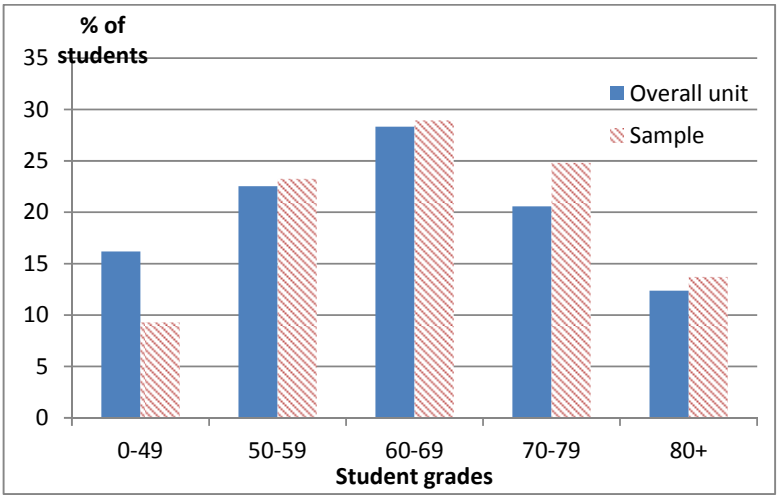

CHART 2: TOTAL HITS BY WEEK

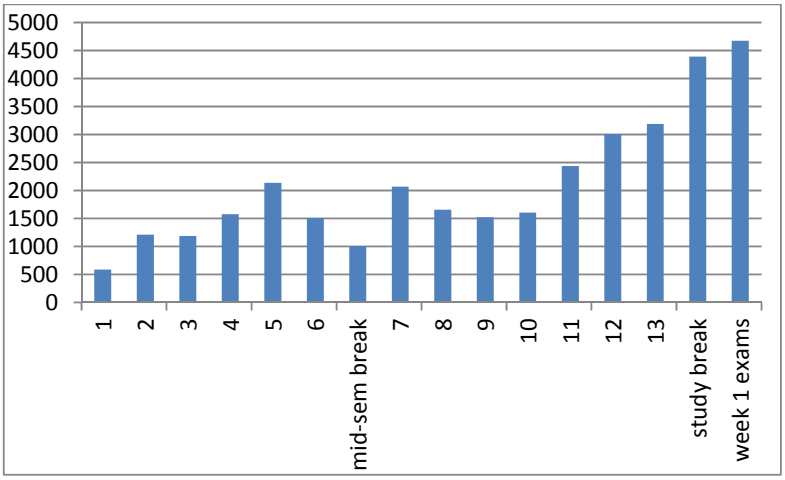

CHART 3: USE OF LECTURE RECORDINGS BY ATTENDANCE AT LECTURES

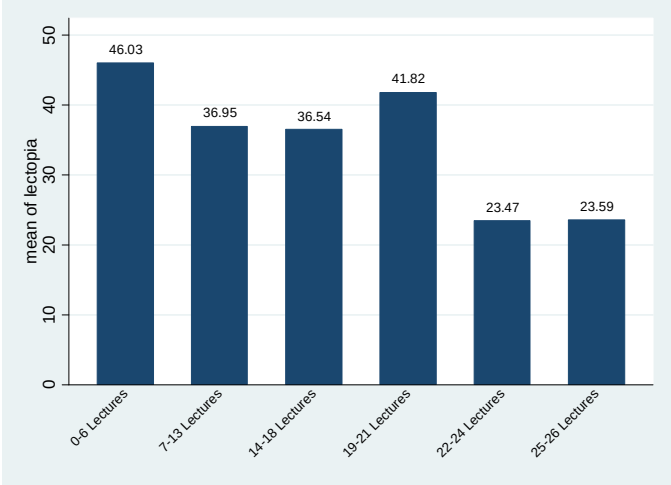

CHART 4: EFFECT ON FINAL MARKS OF LECTURE RECORDING USE, BY LECTURE ATTENDANCE GROUPS

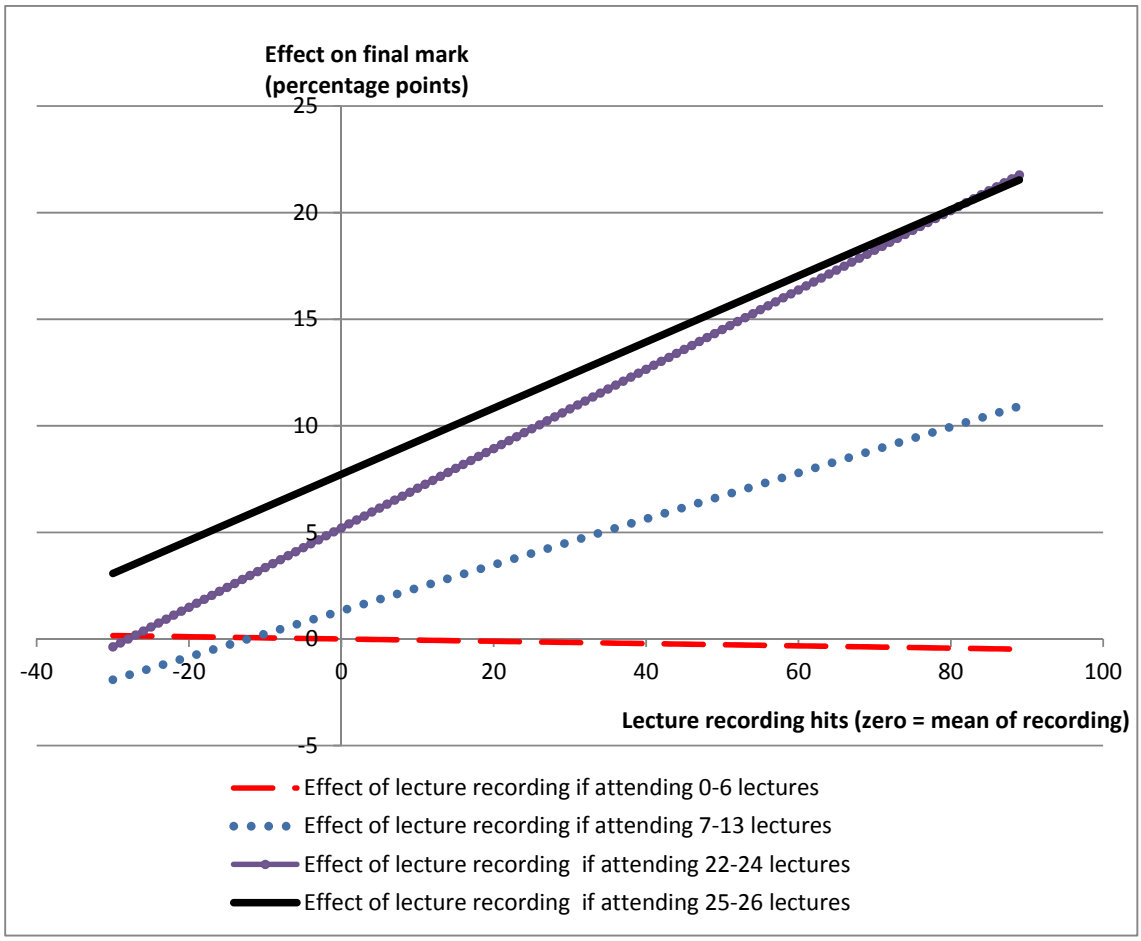

TABLE 1: SUMMARY STATISTICS FOR LECTURE RECORDINGS AND LECTURE ATTENDANCE

	Lecture	Online lecture recording
Observations	387	387
Mean	18.75	33.35
St. Dev	6.91	25.21
Min	0	1
Max	26	119

TABLE 2: PROPORTIONAL REASONS GIVEN FOR USING LECTURE RECORDINGS BY LECTURE ATTENDANCE GROUPING

Lectures attended	Revisit content from lectures	Mainly for study purposes	Prefer them to face-to-face	Timetable clash	Work commitments	Catch up on missed lecture	Not applicable (don't use lecture recordings)	Other	Total students
0-6	0.00	14.29	42.86	20.00	11.43	0.00	2.86	8.57	35
7-13	18.92	10.81	29.73	21.62	8.11	0.00	2.70	8.11	37
14-18	14.29	25.00	21.43	10.71	7.14	8.93	1.79	10.71	56
19-21	41.67	17.86	9.52	11.90	7.14	9.52	2.38	0.00	84
22-24	42.11	13.16	3.95	3.95	7.89	17.11	2.63	9.21	76
25-26	47.44	16.67	3.85	3.85	3.85	11.54	5.13	7.69	78

TABLE 3: DESCRIPTIVE STATISTICS

Variable/ Code	Description	Mean	Std Dev.
Students' Marks			
Mark	Continuous variable for students' final mark in the first-year foundation economics unit at the University of Western Australia.	64.346	12.809
Tertiary Entrance Score			
TER	Continuous variable for students' TER. It is ranked a mark out of one hundred.	89.819	7.367
Gender			
Female	Female students.	0.450	0.498
Male	*Omitted dummy variable for male students.*		
County of Birth			
Aust	Students born in Australia.	0.612	0.488
Born overseas	*Omitted category - Dummy variable for students born overseas .*		
Attendance Type			
Part	Dummy variable for students who study at university on a part-time basis defined as those whose aggregate 'equivalent full-time student unit' for all units of study is less than 0.75.	0.044	0.205
Full	*Omitted category – full-time students*		
Living arrangements			
Parent	Dummy variable for students who live with their parents.	0.749	0.434
College	Dummy variable for students who live in one of the University colleges.	0.059	0.237
Other	*Omitted category – students who live on their own or with non-parents.*		
TEE Subjects Studied in High School			
Econs	Dummy variable for students who studied economics in the final year of high school.	0.432	0.496
Noecon	*Omitted category.*		
Discrete_maths	Dummy variable for students who studied Discrete Mathematics in the final year of high school.	0.494	0.501
Nodiscrete	*Omitted category.*		
Englit	Dummy variable for students who studied English Literature in the final year of high school.	0.212	0.409
Noenglit	*Omitted category.*		
Physics	Dummy variable for students who studied Physics in the final year of high school.	0.297	0.458
Nophys	*Omitted category.*		

School Type			
Cath	Dummy variable for students who attended a Catholic high school.	0.207	0.405
Indp	Dummy variable for students who attended an Independent high school.	0.432	0.496
Govt	*Omitted category – students who attended a Government high school.*		
Repeating the Unit			
Repeat	Dummy variable for students who are repeating the first-year economics unit.	0.111	0.235
Norepeat	*Omitted category – students who are taking the first-year economics unit for the first time.*		
Paid employment			
Work	Dummy variable for students who engaged in paid employment.	0.633	0.483
Nowork	*Omitted category – students who did not engage in paid employment.*		
Work x hours	Interaction variable of the number of hours per week of paid employment multiplied by *Work*.	6.650	7.382
Lecture recording			
LR	Continuous variable for the number of hits registered for lecture recordings (uncentred).	33.35	25.21
Lectures attended			
LEC 7-13	Dummy variable for students who attended between 7 and 13 lectures	0.101	0.301
LEC 14-18	Dummy variable for students who attended between 14 and 18 lectures	0.158	0.365
LEC 19-21	Dummy variable for students who attended between 19 and 21 lectures	0.230	0.421
LEC 22-24	Dummy variable for students who attended between 22 and 24 lectures	0.204	0.404
LEC 25-26	Dummy variable for students who attended between 25 and 26 lectures	0.209	0.407
LEC 0-6	*Omitted variable - Dummy variable for students who attended between 0 and 6 lectures*	*0.098*	*0.298*
Online quizzes attempted			
Quiz 0-1	Dummy variable for students who attempted between 0 and 1 quizzes.	0.111	0.315
Quiz 2-10	Dummy variable for students who attempted between 2 and 10 quizzes.	0.388	0.488
Quiz 11-15	Dummy variable for students who attempted between 11 and 15 quizzes.	0.269	0.444
Quiz 16-20	Dummy variable for students who attempted between 16 and 20 quizzes.	0.124	0.330
Quiz 21-25	Dummy variable for students who attempted between 21 and 25 quizzes.	0.059	0.237
Quiz 26+	*Omitted variable - Dummy variable for students who attempted more than 25 quizzes.*	*0.047*	*0.211*

TABLE 4: OLS REGRESSIONS RESULTS

Dep. Variable: Final mark (%)	**(1)**		**(2)**		**(3)**	
TER	0.780	***	0.785	***	0.805	***
	0.087		*0.086*		*0.086*	
Student characteristics:						
Male students	0.835		-0.024		-0.276	
	1.106		*1.107*		*1.109*	
Omitted: female students						
Born in Australia	-0.442		-0.543		-0.752	
	1.200		*1.186*		*1.189*	
Omitted: born overseas						
Part-time student	0.522		0.816		1.320	
	2.656		*2.612*		*2.631*	
Omitted: full-time students						
Living arrangements:						
Live with parents	-3.238	**	-3.591	**	-3.421	**
	1.554		*1.537*		*1.536*	
Live at university colleges	1.610		1.584		1.648	
	2.481		*2.491*		*2.511*	
Omitted: Other living arrangement						
TEE Subjects Studied:						
TEE Economics (1 = yes)	4.219	***	4.589	***	4.444	***
	1.152		*1.132*		*1.133*	
TEE Discrete Maths (1 = yes)	-6.673	***	-6.726	***	-6.757	***
	1.253		*1.242*		*1.252*	
TEE English Literature (1 = yes)	3.025	**	3.542	***	3.229	**
	1.376		*1.359*		*1.378*	
TEE Physics (1 = yes)	-0.866		0.145		0.042	
	1.377		*1.390*		*1.394*	
Type of high school attended:						
Independent School	-3.709	***	-3.793	***	-4.081	***
	1.293		*1.275*		*1.278*	
Catholic school	-4.115	***	-3.643	**	-3.735	**
	1.543		*1.530*		*1.527*	
Omitted: Government school						
Repeat students	1.750		2.166		2.926	
	1.793		*1.773*		*1.805*	
Paid employment:						
Work dummy (1 = yes)	0.045		0.473		0.519	
	1.549		*1.530*		*1.532*	
Work x workhours	-0.119		-0.101		-0.094	
	0.102		*0.101*		*0.101*	

TABLE 4 (CONT.)

Online quizzes attempted:			
Quizzes = 0-1	-10.627 *** *2.866*	-9.832 *** *2.855*	-9.441 *** *2.912*
Quizzes = 2-10	-10.377 *** *2.515*	-9.788 *** *2.529*	-9.153 *** *2.590*
Quizzes = 11-15	-6.531 ** *2.558*	-6.038 ** *2.566*	-5.491 ** *2.630*
Quizzes = 16-20	-4.458 *2.793*	-4.207 *2.782*	-3.820 *2.815*
Quizzes = 21-25	-5.823 * *3.179*	-6.179 ** *3.132*	-5.573 * *3.161*
Omitted: Quizzes = 26+			
Online lecture recording hits (Lectopia):			
Lecture recording hits (centred)		0.080 *** *0.022*	-0.005 *0.056*
Lecture attendance:			
Lectures = 7-13		2.435 *2.362*	1.322 *2.440*
Lectures = 14-18		4.427 ** *2.147*	3.270 *2.256*
Lectures = 19-21		4.451 ** *2.053*	3.847 * *2.186*
Lectures = 22-24		5.191 ** *2.124*	5.211 ** *2.292*
Lectures = 25-26		7.968 *** *2.107*	7.727 *** *2.230*
Omitted: Lectures =0-6			
Lecture attendance x Lectopia:			
Lectures = 7-13 x Lectopia hits			0.113 *0.088*
Lectures = 14-18 x Lectopia hits			0.100 *0.071*
Lectures = 19-21 x Lectopia hits			0.041 *0.069*
Lectures = 22-24 x Lectopia hits			0.191 ** *0.094*
Lectures = 25-26 x Lectopia hits			0.160 * *0.082*
Omitted: Lectures = 0-6 x Lectopia hits			
Constant	8.498 7.879	2.513 7.869	1.471 *7.920*
Obs Adjusted R^2	387 0.38	387 0.41	387 0.41
Notes:			

TABLE 5: EFFECT OF LECTURE RECORDINGS BY LECTURE ATTENDANCE GROUPS, USING GROUP LECTURE RECORDING MEANS.

Lecture attendance	Group Mean (Centred)	Mark advantage over 0-6 lecture group if view recordings at group mean
0-6	13.03	..
7-13	3.95	1.748
14-18	3.54	3.652
19-21	8.82	4.798
22-24	-9.53	4.184
25-26	-9.41	6.713

Note: the centred mean subtracts the overall mean (33.35) to get a zero mean (see above). This means that, in Column B here, the actual mean for the 0-6 lecture group for example was (33.35+13.03) = 46.38, and the average for the 25-26 lecture group was (33.35+(-9.41))=23.94.

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