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## **Evaluating the use of lecture capture using a revealed preference approach**

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David Neal is the Teaching Spaces Technology Coordinator at Lancaster University. He has developed a keen interest in the use of video and other digital media in teaching. He has also been involved with a number of projects and initiatives to pilot new technologies in the teaching spaces such as video conferencing and interactive whiteboards and smart screens.

### **Abstract**

This article discusses the introduction of lecture capture technology on a large undergraduate module with diverse student cohorts. Literature has so far relied on surveying students to discover their use of the technology or attempted to quantify the impact of watching lecture recordings on assessment performance. Alternatively, the principal contribution of this article is an evaluation of the use of the recorded lectures using a revealed preference approach. Specifically we identify to what extent students watched lecture recordings, rather than simply claimed to watch them when asked to provide comments on the technology. Data indicates the number of distinct students who watched recordings, the frequency with which they watched recordings, the average length of viewings as well as the time of day when lectures were viewed. We monitored viewings over two academic years, identifying 'spikes' in the number of viewings in the days before tests, as well as regularities in the viewing patterns across the two years. We analyse the data to assess the extent to which students used the recordings, how and when they watched the recordings. We conclude that the students value lecture recordings, making more extensive use of the recordings than has been identified in the literature to date. Ultimately, lecture recordings are suggested to offer valuable support for students' independent study.

### **Keywords**

Lecture Capture Technology, Patterns of Usage, Revealed Preference

## **Evaluating use of lecture capture technology in higher education**

The use of lecture capture technology to record lectures and seminars has become increasingly common in recent years in higher education, and there is a growing academic literature assessing its potential advantages and disadvantages. A survey of evaluations of lecture capture technologies highlights a number of advantages and disadvantages of recorded lectures (Taplin et al., 2011). When students could access lecture recordings, they consistently claimed to appreciate being able to watch the recordings to help them understand material, this result being confirmed in the student

survey responses reported in Davis et al. (2009). Much of the literature relies on such student, and to a lesser extent faculty, survey results. Highlighted, in particular, has been the benefit to students from being able to rewind, pause and review lecture recordings (Panther et al., 2011; Al Nashash and Gunn, 2013; Fei et al., 2013), with students finding navigating lecture recordings easier after they had attended the lecture (Panther et al., 2011). The conclusion that students benefit from using technologies that enable them to repeatedly return to material such that they select the pace with which they study had already been highlighted in the literature (Turney et al., 2009). Many studies using student survey results have concluded that recordings were a particularly helpful revision aid (McNeill et al., 2007; Woo et al., 2008; Mark et al., 2010; Panther et al., 2011; Taplin et al., 2011; DiBacco et al., 2012; Fei et al., 2013). Further advantages include lecture capture systems' ease to use, reduced student attrition and increased institutional competitiveness as increasing numbers of universities invest in the technology and universities fear being in a shrinking pool of universities not investing in lecture capture (Greenberg and Nilssen, 2009). Students' use of recorded lectures has also been linked to students developing better study strategies and having better perceptions of a module (Ford et al., 2012).

A consensus has emerged in the literature that lecture recordings are a supplementary resource rather than an alternative to lecture attendance (Davis et al., 2009; Larkin, 2010; Panther et al., 2011; Fei et al., 2013). This is considered in the analysis below. Similarly, screencasts have been found to support rather than replace lectures (Morris and Chikwa, 2014). On the related issue of whether lecture attendance may fall when lecture recordings are available, there is inconclusive evidence on this (Toppin, 2011). However, increasingly evidence has emerged to suggest no significant decline in lecture attendance once lecture recordings are offered (Jones, 2007; Von Kinsky et al., 2009; Larkin, 2010; Panther et al., 2011; Al Nashash and Gunn, 2013; Fei et al., 2013). Despite repeated concerns that lectures do not encourage active learning, students have indicated that they value lectures (Machemer and Crawford, 2007).

Willingness-to-pay for lecture recordings, surveying undergraduate and postgraduate accounting students, has been estimated (Taplin et al., 2011). Interestingly, it was concluded that while students claimed to appreciate the possibility of accessing recorded lectures, only a small proportion of students were willing to pay for this, while many students did not use the resource regularly. This limited use of recordings has been noted elsewhere (Panther et al., 2011). In fact, the literature regarding students' usage of lecture recordings shows mixed results regarding students' usage of the lecture recordings. While Taplin et al. (2011) concluded that students rarely used recorded lectures, Chen and Lin (2012) found that only approximately one third of students accessed recordings, but Leadbeater et al. (2013) and McElroy and Blount (2006) found that 75 - 79% of students made at least some use of the technology. The possible lack of take-up of lecture recordings is a potential disadvantage that is addressed in the analysis below. A further disadvantage of the technology is that both students and lecturers may feel more self-conscious when lectures are recorded (Mark et al., 2010). Nevertheless, the use of lecture capture by students for self-assessment purposes has been found to improve their communication and presentation skills (Smith and Sodano, 2011).

Two analyses of the value of lecture capture technology in undergraduate Economics teaching have been offered (Flores and Savage, 2007; Savage, 2009). Again, a willingness-to-pay approach was used (in Flores and Savage, 2007), as well as an estimation of the impact of the technology on student examination performance (Flores and Savage, 2007). While results indicated that some students would be willing to pay for the facility of recorded lectures, and there appeared to be a positive correlation with watching lecture recordings and examination performance, the authors accepted that applicability of their results was limited by their small sample size. Savage (2009) went on to compare the final examination performance of two classes of undergraduates, comparable except for one group having access to recorded lectures. He concluded that while students who were able to watch lecture recordings performed slightly better in the final examination for the module, the difference was not statistically significant. Again results could not be concluded to be generalizable as the classes were both restricted to only forty students. Nevertheless, watching recorded lectures shortly before examinations was found to improve performance by up to 4 percentage points (Chen and Lin, 2012). Using a larger sample of 312 students they also were able to conclude that students who failed to attend classes and male students were more likely to watch the lecture recordings.

A revealed preference approach is characterised by the observation of consumers' (in this case students') actual demand (and usage) for a good or service such that consumers' preferences can be

better understood. This approach allows us to measure the extent to which the technology is used, including its use around revision periods, rather than claimed to be used and valued by students. As such, the results are intended to be more reliable on student usage of the technology than those that rely on student survey results. There are already at least two examples of the use of a revealed preferences approach in the evaluation of lecture capture technology. However, the first is in the context of a small Operating Systems module taken by thirty seven students (Chandra, 2007), while in the second, lecture recordings were only made available to a full student cohort for one month (Andrews et al., 2013).

Ultimately the literature indicates a number of potential advantages of recorded lectures, and a smaller set of disadvantages. Lecture recordings are considered a supplement rather than an alternative to lecture attendance. Nevertheless, a consensus has yet to emerge on student usage of recorded lectures, while willingness-to-pay for the technology and its impact on student performance both appear limited.

It is clear from the above that there is a need to, first, evaluate the lecture capture technology using the revealed preference approach that has only rarely been used in the academic literature to date, using larger cohorts of students than have been considered previously. This will provide an insight into how students use the technology, and whether it is used to supplement or replace lecture attendance. Second, in using a revealed preference approach with large classes of students, further evidence can be gleaned on the extent to which students use the technology rather than claim to use it in surveys of recorded lecture usage. This is crucial as the discussion above highlighted the mixed results to date on the extent to which students use recorded lectures. Further, this gap in the literature regarding whether students use lecture recordings as much as they may claim in surveys has been previously identified (Settle et al., 2011). As indicated already, much of the literature typically focuses on student and faculty questionnaire responses to the value of lecture capture technology, or estimates the impact of lecture capture usage on examination performance. There is still a need to better understand student views on the technology, to provide supplementary evidence on students' perceived benefits of the technology as well as their usage of it. Hence, third, it is valuable to consider student views of the lecture capture technology that are unsolicited and offered without prompt, rather than in response to questionnaires on the technology. Such evaluations have not been reported in the literature to date, but are crucial as they avoid the concern with some of the literature that relies on survey responses, namely that survey respondents may overstate their demand for a product or service when asked directly to value it.

## **Research methods**

Two research methods are used. First, data on student usage of lecture recordings are analysed to identify students' demand for lecture recordings, namely a revealed preference approach is adopted. Second, qualitative data in the form of student responses to three online surveys are collated, two specifically asking students for feedback on the facility to watch recorded lectures, but crucially the third being standard module evaluation questionnaires,.

### *Module context and data sources*

The lecture capture technology was initially introduced on a trial basis on a number of undergraduate and postgraduate modules, taught across a top 10 ranked UK university in the 2012-2013 academic year. The technology has since continued to be used. The first year undergraduate Economics module was identified as a key module for the initial trial as it was the largest module taught at the university, with 728 students registered in the 2012-2013 academic year, and 711 in the subsequent academic year. It was taught to a diverse student cohort, encompassing students new to the subject but also those with A level Economics (or equivalent). Students included those registered for a BSc Economics degree or an Economics degrees joint with other disciplines, students required to study at least one year of Economics as part of a Management School degree, and students taking the subject as a 'minor' for one year only. However, note that there were a number of changes to the module since the 2011-2012 academic year, including changes to the lecturing personnel, an increase in the number of lecture hours per student per week from two to three, and substantial changes to the syllabus taught.

Teaching on the module lasted 24 weeks, with students expected to attend 3, 50 minute lectures per week, plus a weekly seminar of approximately 15 students. In total, 70 different lectures were given during the module in an academic year. Given lecture room size constraints, each lecture had to be delivered three times in a day, typically at 10am, 1pm and 2pm. Each 1pm lecture was recorded, so that any lecture being recorded had already been given once that day. Typically recorded lectures would be made available to students on the module within a day of the lecture taking place, and students would access the lecture recordings from the virtual learning environment. During the twenty four weeks of the module each year, students sat four tests, at the end of the 6<sup>th</sup>, 12<sup>th</sup>, 18<sup>th</sup> and 24<sup>th</sup> week of the module. In the 2012-2013 academic year, each of the tests took a multiple choice format. However, in the 2013-2014 year, the second and third tests required students to write short answers, the first and fourth tests remaining multiple choice question tests. An incentive mechanism operated on the module: if a student obtained at least 45% in each of the four tests, and an overall average of at least 60% across all four tests, then they were exempt from sitting a final examination in the module. The final examination comprised multiple choice questions, as well as students being expected to answer two essay questions. In both academic years the fourth test needed to be marked particularly quickly so that students would know whether they would have to take the final examination. Consequently, a multiple choice format of the fourth test was particularly attractive.

#### *Viewing statistics data*

The Panopto lecture capture technology used automatically collates information on the number of individuals watching lecture recordings, when the recordings were viewed, and the length of viewings. We monitored the viewings of the recordings over two academic years, 2012-2013 and 2013-2014. Consequently, we could analyse the data to assess accurately the extent to which students used the lecture recordings, and also how and when they watched the recordings.

Note that the data identify individual students by their unique student identifier rather than by name, in effect ensuring that the data observations are anonymised prior to analysis. Some views of the lectures were by the module lecturers, to confirm that the lectures had recorded successfully. These data points could be easily identified and removed from the dataset prior to analysis of the viewing statistics. It is also pertinent to note that if a student started watching a recording and paused, repeated and/or skimmed over part of the recording the Panopto technology recorded how long the viewing lasted in total. However, the data do not indicate which part(s) of the recording were viewed. Further, the length of viewings is recorded in full minutes. As will be highlighted in the analysis below, in both years there were a large number of viewings lasting 0 or 1 minute. We are unable to confirm whether such short viewings were to check that viewings were available or made by students who wanted to check very small details relating to lecture content. Nevertheless, sorting the raw data according to the unique student identifiers, the recording viewed and the length of each viewing revealed that in the vast majority of cases when students watched a recording for 1 minute or less, the student then watched the same recording again, at least once with viewings lasting longer. Hence, we speculate that many viewings of 1 minute or less were indeed to check that recorded lectures were accessible. The data were used to obtain an accurate picture of the extent to which the students used the recordings, and as such a revealed preference approach was adopted.

#### *Student evaluation*

Information specifically on students' views of the lecture capture facility were collected via two methods, with the general module evaluation questionnaires offering students further opportunities to express their views on the technology. In each case, students were reassured that the information they provided was collected anonymously.

First, students were invited to provide comments specifically on the lecture capture technology through the virtual learning environment (VLE), the invitation to provide comments always appearing at the top of the module VLE page. Relatively few students responded to this invitation, 22 students posted views on the technology in 2012-2013, and 20 students responded in the 2013-2014 academic year. This response rate is very low but students were given no particular incentive to respond to the request for comments.

An online questionnaire was also created, asking students specifically to evaluate the lecture recordings. This questionnaire was available to students in early December 2012 at the end of the

first term when the lecture capture technology was being trialled and 216 valid questionnaires were completed, indicating a 30% response rate.

As standard, all modules across the university are evaluated by online module evaluation questionnaires, with students registered on the modules receiving emails prompting them to complete the questionnaires. In each academic year, students registered on the first year undergraduate Economics module were emailed, asking them to complete these questionnaires at the end of the Microeconomics and Macroeconomics parts of the module. The response rate for these questionnaires again was consistently around 30%, with over 200 responses to each questionnaire. Note that this response rate is comparable to that reported in DiBacco et al. (2012).

## Results

### *Analysis of lecture recording data*

The data collated indicates the number of distinct students on the module who watched the lecture recordings, but also indicates the frequency with which they watched the recordings, and the average length of viewings.

Figure 1 below summarises viewings of the lectures across the weeks of the academic year 2012-2013, with the lecture viewings from the 2013-2014 academic year indicated in Figure 2.

Figure 1 to appear here

What is of particular note is not only that there are clear 'spikes' in views associated with each week in which a test took place, but also that as the 2012-2013 academic year continued, not only was there some increase in the number of unique students accessing the recordings, but also that the number of viewings by these students increased over time, presumably reflecting the students' growing recognition of the value of the lecture recordings. The spikes in the test weeks support the claims made in the questionnaires discussed below, that lecture recordings are valuable for revision purposes.

Figure 2 to appear here

A similar viewing pattern emerges across the 2013-2014 academic year, with larger 'spikes' associated with successive tests, except for the final test. This may reflect students' knowledge that the final test would revert to a multiple choice question format. However, there was then a larger increase in viewings prior to the final examination compared to the previous academic year as students prepared for an examination which was anticipated to be more challenging, requiring greater depth of Economics knowledge in the answers to essay questions. Inspection of the viewings data to identify which lectures were viewed most often revealed that in both academic years there was a general tendency for lectures later in the academic year to be viewed more often, with the exception of revision lectures.

The values in the first two rows of Table 1 highlight the many instances of students watching only a very short amount of a recording, possibly to confirm that they are able to access a recording even if they do not want to watch the recording then. Hence, in Table 2 below only viewings of 2 minutes or longer are considered, while in Table 1, figures for lecture viewings first include all viewings, and then lecture viewings of 2 minutes or more, in an attempt to focus on those viewings of actual lecture content rather than as a check to ensure that recorded lectures are accessible.

Table 1 to appear here

A number of results emerge from the statistics reported in Table 1. In the first year of operation, 639 or 87.8% of students accessed the recordings at least once, with 613 or 84.2% of students watching at least 2 minutes of a recording. These statistics rose in the most recent academic year with an impressive 709 or 99.7% of students accessing the recordings at least once, with 680 or 95.6% watching at least two minutes of a recording.

Focusing on the final column of Table 1, in the 2012-2013 academic year approximately 35% of students watched at least two minutes of any lecture, this rising to approximately 39% in the later academic year, while on average, each student watched at least two minutes of approximately 41% of the module lectures in each year, i.e.  $34.7\% = [(252.3/728) * 100]$ ;  $39.1\% = [(278.7/711) * 100]$ ;  $41.1\% = [(28.8/70) * 100]$  and  $41.0\% = [(28.7/70) * 100]$ . These figures all indicate considerable take-up of the recorded lectures, even in the first year of the lecture capture technology being adopted, but also indicate robustness in the results across the two years of data.

When restricting attention to viewings of at least 2 minutes, the average length of any viewing was approximately 28 minutes in both academic years. Again considering viewings of at least 2 minutes, in the 2012-2013 academic year 81.2% of viewings lasted between 2 and 49 minutes, with 18.8% of viewings lasting the lecture length of 50 minutes or longer. In the more recent academic year 73.5% of viewings were shorter than the lecture length, with 26.5% of viewings lasting longer than 50 minutes. These figures are noteworthy as indicating that students were not necessarily watching complete lecture recordings, instead watching parts of the recorded lectures. This supports the hypothesis that the students did not watch lecture recordings as a substitute for live lecture attendance, but rather used lecture recordings to review material that may not have been clear to them when presented in the actual lecture. While lecture attendance was not recorded, the statistics also add credibility to the lecturers' impression that lecture attendance did not noticeably decline after lecture capture was introduced.

Panopto automatically saves information on when lecture recordings are accessed. We have therefore been able to investigate when students accessed recorded lectures. This is of particular interest given the 'spikes' in demand for recorded lectures preceding tests and final examinations. The results in Table 2 suggest that while the students may use the recordings for revision purposes, the statistics do not indicate that substantial numbers of students are 'cramming' for tests and examinations, working through the night to catch up on their studies.

Table 2 to appear here

#### *Student questionnaire comments*

The number of responses to the invitation to provide comments through the VLE was very low in each of the two years and as such, the usage statistics in Table 1 may give a more accurate reflection of students' perceived value of the technology. Nevertheless, the responses received were overwhelmingly positive. Appendix A contains details of the questions asked, and representative responses across both years of the study for the sake of brevity. A number of themes emerge from the responses summarised in Appendix A. Some students found the lecture recordings useful if they could not attend a lecture for whatever reason, but more significantly, many students highlighted how watching the recordings helped them revise and understand material that they struggled to comprehend in the lecture. Consequently, the technology appears to have had a real benefit in aiding independent study by students. The comments in Appendix A provide further support for the hypothesis that students used the lecture recordings as a supplement rather than a substitute for lecture attendance.

Appendix B summarises the questions asked in the online recorded lecture questionnaire, mean and standard deviations of scores to closed response questions, and representative comments solicited from the more open-ended questions. Again many respondents highlighted how the lecture recordings were believed to be helpful for revision purposes, but a number of respondents also highlighted how the recordings enabled students to produce better quality notes after a lecture, with one respondent indicating that the resource was particularly valuable for students with learning difficulties. Students' expressed views were again very positive, as also indicated in the scores out of

a maximum of five given to the closed-ended questions. Interestingly, two students indicated opposite views on whether they were able to concentrate better in a 'live' lecture or watching a recording. A weakness highlighted was that the recordings did not capture lecturers pointing at specific areas on a lecture whiteboard. The fixed camera did not focus on the lecture room screen. Rather, it recorded the lecturer, provided that they stayed near the workstation, and separately whatever was projected from the computer onto the lecture room screen was recorded. Following this feedback, lecturers took care to indicate verbally, for example, which part of a PowerPoint slide they were discussing. Finally, a number of students felt that recorded lectures should be available for all lectures and modules.

Nevertheless, there is a concern that survey respondents may overstate their demand for a product or service when asked directly to value it, especially when responses are not linked in any way to possible requests for payment for the product or service provided. Further, although the online questionnaire results highlighted an issue about cameras not being able to pick up all lecturers' actions, it is clear that there is a danger that those students who particularly liked the lecture capture technology might have been most willing to complete an online questionnaire on the technology, raising the doubt of possible selection bias in respondents. Hence, of particular interest and greater value are comments students made regarding the lecture recordings in the standard Microeconomics and Macroeconomics module evaluation questionnaires in both the 2012-2013 and 2013-2014 academic years. Generally, module evaluation scores were higher for the module after lecture capture was introduced, particularly in 2012-2013 – the first year the technology was trialled. These questionnaires included two open-ended questions: 'What were the most valuable parts of the module?' and 'How could the module be improved?' but no part of the questionnaire directly mentioned the recorded lectures. Consequently, the comments offered on the lecture capture technology are particularly valuable as unsolicited. Comments from these questionnaires are provided in Appendix C. Again the theme that emerges is that students found the lecture recordings very valuable, helping them with revision and to go over materials that they struggled to comprehend in the lecture. Ultimately, recorded lectures seemed not to be perceived as an alternative to lecture attendance, but a very useful tool to assist follow-up study. The comment made by one student regarding the pace of delivery of lecture material is particularly interesting. As students come to regard the viewing of at least parts of recorded lectures as standard, this may allow lecturers to increase the amount of material covered in any lecture, giving lecturers scope to deliver lectures with broader or deeper coverage of material.

## **Conclusions**

This article has examined the adoption of lecture capture technology over two years in large, first year undergraduate cohorts of students. By considering a module with over 700 students in any year, it is intended that the results can be considered to have a wider applicability than those from analyses of relatively small samples of students. Two years of data are used to confirm the robustness of results obtained.

Students responded very positively to the technology when asked about it on the virtual learning environment and in an online questionnaire. In particular, students highlighted the benefits of using recorded lectures for revision purposes, to support independent study and understanding of material that they found challenging when introduced in lectures, and as of particular value for international students and students with special learning needs. However, there is a fear that students may overstate their preferences for a service/technology when asked directly to evaluate it. Consequently, additional, positive comments that students offered, although unsolicited, in online module teaching questionnaire responses were particularly valued. Such unsolicited views have to date not been reported in the literature evaluating lecture capture technology. Ultimately, two key themes in the various solicited and unsolicited forms of evaluation emerged: students valued the facility to watch recorded lectures to develop and clarify lecture notes, and recorded lectures were seen to be an important revision tool.

Students' revealed preferences for recorded lectures were identified through analysis of viewing statistics which offered a vital opportunity to assess usage of the lecture capture facility, an approach typically not taken in the literature, but which complements existing research methods. The first important conclusion to be gleaned from the viewing statistics is that the basic usage figures are higher than reported in the literature to date, with at least 84% and 95% of students accessing videos



in the two years of the study. These viewing statistics highlight the impressive take-up of the recorded lecture resource in its first year of operation, with take-up figures even higher in the second year. This result provides an important contribution to the literature regarding students' usage of lecture recordings, as existing results are mixed regarding students' usage of the lecture recordings (Taplin et al.; Chen and Lin, 2012; Leadbeater et al., 2013; McElroy and Blount, 2006). Hence, the results reported here offer the strongest evidence yet of students' widespread use of recorded lectures. It is possible that over time students are acquiring more devices on which they can access recordings, for example tablet and mobile telephones, as well as laptop computers. In addition, this study considers students' actual viewings of recorded lectures, rather than their recollections or claims to have watched recordings, so it is intended that the results reported here are at least as reliable as those which relied on student survey responses.

Statistics also confirmed the themes from questionnaire comments: as the average length of a lecture recording viewing was less than 30 minutes while the live lectures lasted 50 minutes, lecture recordings can be demonstrated to have been used to supplement rather than replace lecture attendance, with viewings used to review parts of lectures that had initially been found difficult to understand. This supports results previously reported in the literature (McElroy and Blount, 2006; Davis et al., 2009; Settle et al., 2011; Taplin et al., 2011; Toppin, 2011; Cooke et al., 2012; Leadbeater et al., 2013). Nevertheless, viewing statistics allow us to substantiate reported students' claims regarding the use of recorded lectures as a supplement to lecture attendance. In fact, it had previously been concluded in the literature that while students find viewing recorded lectures helpful to review material, students preferred face-to-face lectures because they appreciated the opportunity for interaction with faculty and peers, the ability to ask questions, giving rise to better engagement with the material being discussed (Panther et al., 2011). Note that it has additionally been found in the literature that stronger students' viewings of the recordings were shorter with fewer repeated viewings (Owston et al., 2011). The spikes in viewings identified before tests highlight how students use the recordings as part of their revision, providing further support for this conclusion in the literature (Mark et al., 2010; Panther et al., 2011; DiBacco et al., 2012; Andrews et al., 2013; Fei et al. 2013). Ultimately, the results indicate that recorded lectures can be a helpful tool, facilitating independent study by students.

A major limitation of the research is that data were not available on individual students' test and final examination results such that the impact of use of recorded lectures, as well as individual student characteristics on student performance could be quantified. It is hoped that this research will enable universities to recognise the value of providing researchers with information on student module results and student characteristics such that the impact of lecture capture on student performance can be quantified in modules with large numbers of students. Research that has estimated the impact of lecture capture on student performance typically often is limited to modules with relatively small student cohorts. A second limitation is that the extent to which student satisfaction, measured in higher mean module evaluation questionnaire scores from the 2012-2013 academic year onwards, cannot be attributed to the availability of recorded lectures due to other changes made to the module each year, a difficulty also faced by Settle et al. (2011). The research is also limited through its reliance on data from one UK university, and in particular from the use of lecture capture in just one discipline at that university. Future research should test whether the impressive take-up of recorded lectures by students is an anomaly, or reflects growing recognition of the value to students of lecture capture. Further topics for future research include the extent to which student usage of recorded lectures offers a possible tool for formative assessment, and preferences for lecture capture versus flipped classrooms, both for faculty and students.

A number of students in their questionnaire responses on the use of lecture capture suggested that they wanted lecture recordings available for every lecture, across all modules taken. This raises the question whether individual lecturers and module leaders should have the freedom to decide whether lectures are recorded, or whether this is a university level decision. However, this debate goes beyond the remit of the current analysis. It is noted that universities have adopted different positions on this issue, and some students and faculty feel greater self-consciousness when lectures are recorded (Mark et al., 2010). Nevertheless, ultimately this article highlights the benefits of lecture capture when it is adopted, with the students making extensive use of the lecture recordings, but crucially using the recordings to supplement rather than replace lecture attendance. Students made greater use of the lecture recordings in the days preceding tests and examinations, themselves identifying the benefit of watching lecture recordings so that they could gain better understanding of

material, developing notes taken in class. As such, lecture capture offers an attractive facility to enhance independent student study.

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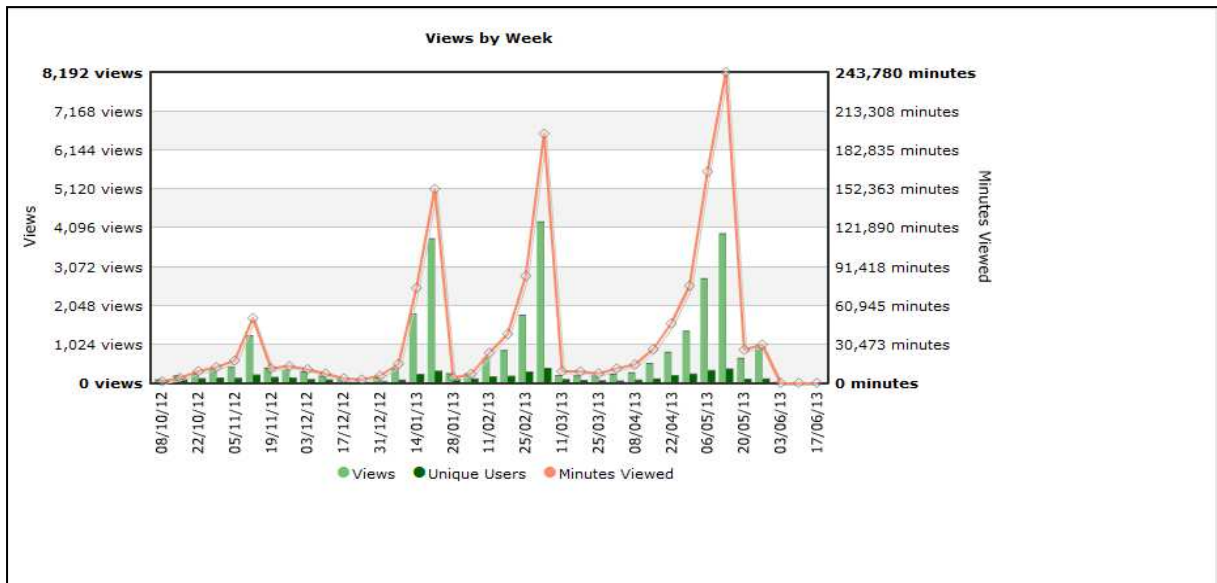
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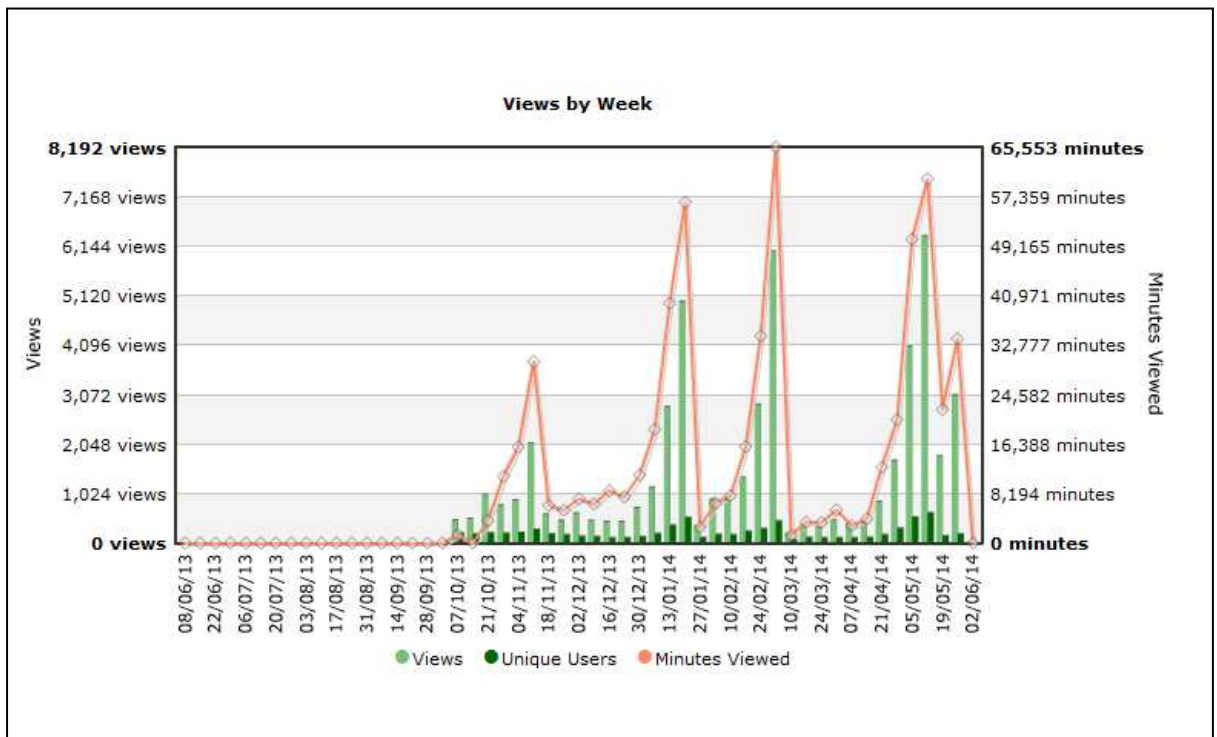
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**Figure 1. Recorded lecture viewings 2012-2013**



**Figure 2. Recorded lecture viewings 2013-2014**



**Table 1. Recorded lecture viewing statistics**

<b>Variable</b>	<b>Year</b>	<b>All Viewings</b>	<b>Viewings 2 minutes or more</b>
Number of views	2012-2013	29,238	17,663
	2013-2014	47,475	19,512
Unique students	2012-2013	639 (87.8%)	613 (84.2%)
	2013-2014	709 (99.7%)	680 (95.6%)
Mean view length	2012-2013	17.2 minutes	28.0 minutes
Standard deviation		23.0	24.3
Mean view length	2013-2014	11.6 minutes	27.8 minutes
Standard deviation		19.4	21.3
Mean views per lecture	2012-2013	417.7	252.3
Standard deviation		253.9	180.9
Mean views per lecture	2013-2014	678.2	278.7
Standard deviation		312.6	168.1
Views per student	2012-2013	45.8 (65.4%)	28.8 (41.1%)
	2013-2014	67.0 (95.7%)	28.7 (41.0%)

Note: Where appropriate, percentages are provided in parentheses next to counts.

**Table 2. 24 hour recorded lecture viewings**

<b>Hour Accessed</b>	<b>2012-2013</b>	<b>2013-20134</b>
0.00 – 05.59	1,867	1,819
06.00 – 11.59	2,318	2,826
12.00 – 17.59	7,478	8,020
18.00 – 23.59	6,000	6,847
Total viewings	17,663	19,512

## Appendix A. Student VLE comments

*We'd like to use your feedback in our review of the 'lecture capture' pilot, so please tell us whatever you think might help us decide what next.*

*Tell us about how you used the recording. Did you watch it right through? If not, which part did you watch? Why only that part? Do you think this recording will help your learning? How? Do you have any recommendations for us to improve how the recordings are made?*

A great idea to record the lectures and very helpful for revising! Thank you!

The lecture capture project has thus far been brilliant, it is extremely helpful if and when my notes have proved illegible and/or incomplete. More importantly it is extremely handy as the first place to go to return to something I didn't entirely understand the first time round. It has helped me enormously.

Extremely useful- I wish lectures for all my modules were recorded.

Very useful. Recordings are clear, visual and sound quality is good. I feel that having the ability to pause and repeat parts of lectures which were originally challenging will help improve my understanding.

Found them really useful for revision. Even if you attend the lectures and take notes, it can be very useful to check through the lecture again if there was a specific part you need to clarify.

As I have dislocated my knee and am unable to leave my flat, the recorded lectures have proved not only useful but essential to me being able to keep up with the course. If only all departments used such a system!

Video is helpful, I can review the missed sentences during the class or sometimes things I didn't understand.

I think the idea of recording lectures is amazing and really helpful for self-study.

As I am an international student, some problems of understanding happen in the lecture but I can understand it perfectly after replaying the records.

I didn't watch the whole lecture but all the mathematic explanations. Now I'm well prepared for the next lecture.

It was really good to have the opportunity to go back on the lecture and review diagrams with the explanations of the lecturers at our own speed.

## Appendix B. Recorded lecture questionnaire responses

<i>The quality of the recording was excellent</i>		
Mean = 4.27	St. Dev. = 0.74	N = 206
<i>The video of the lecturer was useful</i>		
Mean = 4.55	St. Dev. = 0.70	N = 209
<i>The recording was useful for coursework or end of term assessment</i>		
Mean = 4.29	St. Dev. = 0.80	N = 200
<i>The recording was useful for catching up on a missed lecture</i>		
Mean = 4.70	St. Dev. = 0.57	N = 197
<i>The recording was useful for reviewing hard to understand concepts</i>		
Mean = 4.52	St. Dev. = 0.70	N = 209
<i>The recording will be useful for future exam revision</i>		
Mean = 4.51	St. Dev. = 0.70	N = 211
<i>What difference did lecture recordings make to your experience in the lecture itself (tick all that apply)?</i>		
<i>I concentrated harder on the lecturer</i>	N = 43	19.91%
<i>I concentrated less on the lecturer</i>	N = 16	7.41%
<i>I made more notes during the lecture</i>	N = 31	14.35%
<i>I made less notes during the lecture</i>	N = 33	15.28%
<i>I asked more questions</i>	N = 8	3.70%
<i>I asked fewer questions</i>	N = 16	7.41%
<i>I didn't attend the lecture</i>	N = 6	2.78%
<i>I didn't know the lecture was being recorded</i>	N = 3	1.39%

## Appendix B continued. Recorded lecture questionnaire responses

<i>Any other comments on the usefulness of the recordings</i>
Everything is perfect
Good to have there as a back up
The recordings are of great help, especially in economics, in which some theories and concepts are very hard to understand instantly.
It's very good for us to review lectures, maybe the workshop should also have records
Incredibly helpful to students with learning disabilities
Excellent and should be done for all lectures across university. It means that I can attend the lecture and try to understand rather than hurriedly writing notes.
I love the idea of recording Lectures! It helps me a lot to understand the lectures clearly
It allows me to be able to check what I have noted down is correct, that I have understood what the lecturer is saying
I'm really glad that the lectures were recorded, it really helped with revision.
I have found it very useful to be able to rewatch and to be able to pause parts of the lectures.
Every lecture should adopt the lecture recording scheme. If I found a lecture particularly difficult, I can watch it, and pause when necessary to make notes to aid understanding.
Helped me a lot, especially because I'm not native English speaker and there were parts where I had to listen to it and repeat more then once to follow her point. Provides me with the opportunity to listen carefully to the lecturer, not caring about not taking notes.
As I can be distracted very easily, for examples by the small noises made by other students, ... Therefore, by watching the lecture recordings, it makes life easier... I can be 100% focused on watching the lecture recordings in my own little space, take down my notes, even if I cannot follow up the speed of the lecturer or if I have missed some points, I can still replay them several times and listen carefully to the important points that the lecturer has mentioned. This has much improved my understanding on the course. The only problem of this method is that there is no chance of interacting with the lecturer. However, questions can still be asked during the tutorial section so I do not think that this is a big deal.
The lecture recordings where useful for revision, because I could pause them and take extra notes. I however get less distracted during real lectures and find them easier to follow. For this reason I have only skipped a couple since the beginning of the year
It made me more confident that I could understand the topics on two levels, both through attending the lectures, but also by watching the lectures again if I didn't understand and making notes
I wish the recordings were taken from the centre in the lecture theatre, so that we can see what the lecturer is pointing at on the screen.
The lecture recordings are very helpful. I think that they had a big influence on my exam preparation.



## Appendix C: Module questionnaire responses

### *Microeconomics questionnaire responses*

<i>What were the most valuable parts of the module?</i>
Lecture recordings help when looking back on notes and during revision
The video recordings for revision
The recording of the lectures to look back on - helps with revision a lot
lecture recording (16 separate responses indicated this)
The effort of recording and uploading the lectures' recordings on Moodle! =)
The lecture recordings helped a lot.
Being able to watch the lectures again online, this helped a lot with revision.
<i>How could the module be improved?</i>
Because of the success of the video capture I think the 'pace' of the lecture could be sped up to cover more material. The lecturers will repeat points (for emphasis) but this takes up time and with the video if I miss something I know I can always watch it later

### *Macroeconomics questionnaire responses*

<i>What were the most valuable parts of the module?</i>
The fact that the lectures were recorded meant that even if I didn't understand it the first time I could go through it at my own pace afterwards.
Lecture recordings online (14 separate responses indicated this)
The recording facilities have been extremely helpful in assisting with my studies. Can't imagine revision without the recorded lectures.
Being able to view the lectures online so I could make sense of everything that was said.