

E-LEARNING PROJECT REPORT: VIDEO LECTURES FILMED BY STUDENTS

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Abstract. The purpose of this e-learning project was to test the effectiveness and viability of getting students to film mathematics lectures and the effect on student learning of making these videos available. The project was made possible by an E-Learning Development Grant (ELDG) and by the cooperation of a large number of people who I thank at the end.

Disclaimer. The project analysis is not scientific: there is no attempt made at comparison with a control group, the data sets are not large and the statistical methods used to analyse them are crude. This report is intended to be at best a rough guide to the UCL Mathematics Departmental Teaching Committee as to what action to take on filming of mathematics lectures.

1. Context

The way we teach mathematics at UCL (like at many other mathematics departments in universities across the world) is predominantly through lectures delivered at a board. The existing lecture-capture technology (Lecturecast) used at UCL is ill-suited to filming boardwork and depends on the lecturer preparing slides; the Lecturecast system displays these slides alongside an audio recording of the lecture and, optionally, superimposes a small, grainy video of the lecturer in the corner of the screen. It is important that e-learning technologies dovetail with current teaching practice (otherwise they are unlikely to be adopted widely), so I thought it was important to find a workable solution to capture boardwork.

1.1. Why is it important to film lectures?

- UCL is “London’s global university”: a huge number of our students are international students and English is not necessarily their first language. I think it is useful for those students to be able to review lecture content at their own pace with a pause facility. Knowing my own lecturing speed, I suspect that a pause facility would be of use for all students, regardless of their mother tongue.
- Students retaking courses (for any number of reasons) often cannot attend lectures a second time around. Video lectures could be extremely useful for these students’ learning (in particular for their revision).
- UCL has a huge and complex timetabling problem, and the existence of video lectures could be very advantageous for students caught in some of the resulting clashes.

1.2. **The project.** The solution I proposed and which was tested in this ELDG-funded project was:

- To borrow a good quality video camera from the e-learning department.
- To use this camera to film two second-year 30-lecture courses (MATH2101 and MATH2401) in their entirety.

- To employ four students (from outside the target classes) to operate the camera.
- To make the recordings available on Lecturecast (Lecturecast is both a recording and distribution system: we would be making use only of the distribution part of the system).

In practice, the courses were not filmed in their entirety:

- The MATH2101 lecturer used “problems classes” and “lectures” interchangeably to deliver content, but we had only timetabled the filming of hours designated as “lectures”.
- Due to a couple of minor technical teething problems, one or two early lectures were missed.
- Also, due to technical hold-ups in the early stage of the project, the MATH2401 lectures were uploaded to Youtube rather than Lecturecast.

1.3. Questions addressed in this report.

- What proportion of our students made “heavy use” (or, indeed, any use) of the videos?
- Is Lecturecast or Youtube a better medium for disseminating the videos?
- Is there any evidence to support the idea that international students make use of the videos more than their home student counterparts?
- What were the patterns in usage and what does this tell us about how the students were using the videos to complement their other learning strategies?
- Was there an effect on lecture attendance?
- Is it worth pursuing video lecture-capture or another alternative to Lecturecast’s recording system?

2. Methodology

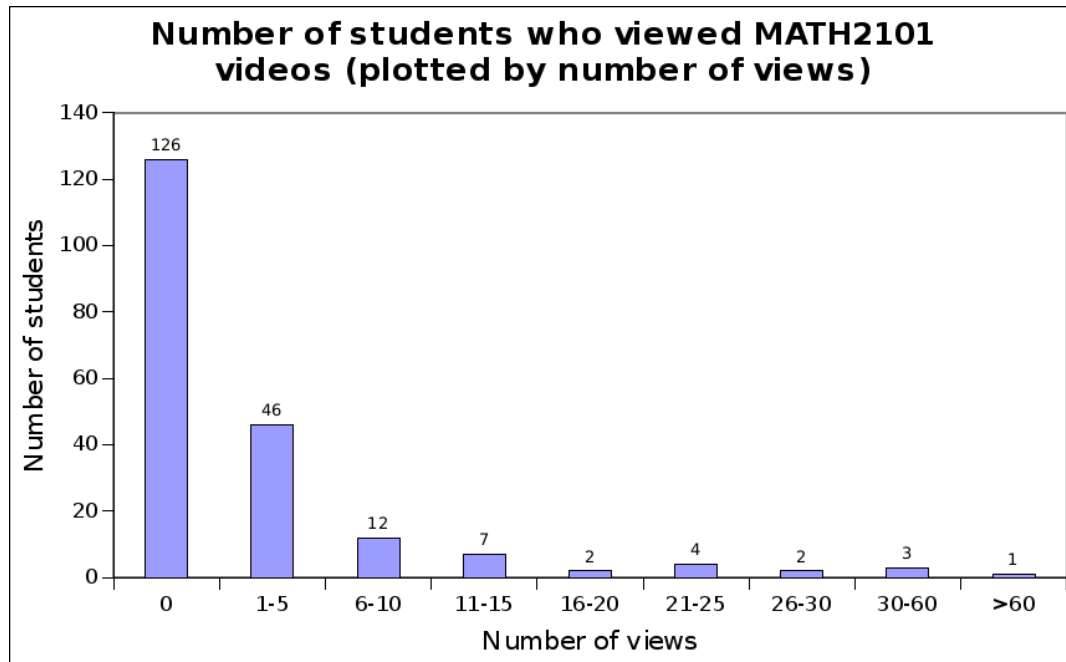
We took two of the second year courses which are compulsory for many of the students as the subjects of our study.

- MATH2101: 189 students (94 international students) plus 14 resit students
- MATH2401: 174 students (80 international students) plus 14 resit students

Since these courses are mostly compulsory I have nothing to say about resolving lecture clashes, but I will be able to make some comments about resit students (there were a small number resitting each course).

I asked for student feedback on the project at various stages:

- At the beginning of the project (after a few videos were available): most of the feedback was to complain about the audio quality. This was due to a problem with the microphone which we were unable to fix.
- At the end of the lecture course: very little feedback was received, but what we did receive was mostly positive.
- After exams: very little feedback was received, but what we did receive confirmed that the videos had been useful for revision for most of the students who left feedback.



Much more useful than student feedback were the usage statistics available on Lecturecast and Youtube. Due to differences in the available data from each source, different data sets will be used to study the different questions above. In particular, MATH2101 data from Lecturecast is broken down into individual statistics per student but it not very fine-grained temporally (at best weekly hits), whereas MATH2401 data from Youtube gives clear usage statistics on a daily basis but no individual data.

3. Results

3.1. What proportion of our students made “heavy use” (or, indeed, any use) of the videos?

3.1.1. *MATH2101*: Above is a column chart showing how many students viewed MATH2101 videos a certain number of times. This shows that 62% of students did not view any videos, and only 15% of students viewed more than five times over the entire duration of the project. There was a small number of “power-users” who made extensive use of videos. Note that there was also a small number of students not taking the course who viewed the videos.

3.1.2. *MATH2401*: During the lecture course there were an average of 5.9 unique users per day; during revision period there was an average of 4 unique users per day, reaching 13 per day in the final week before the exam. This is out of a total of 174 students. It is not possible to tell from the Youtube data which of these unique users are return visitors, and hence it is not possible to tell what fraction of our students used the videos in total.

3.1.3. *The post-exam survey*. had the following results (16 nonempty responses):

- I used the MATH2101 videos while I was revising: 10/16 (2/10 rated them as unhelpful, 8/10 rated them as helpful or very helpful)
- I used the MATH2401 videos while I was revising: 13/16 (2/13 rated them as unhelpful, 11/13 rated them as helpful or very helpful)

- I used the MATH2101 videos during the lecture course: 9/16
- I used the MATH2401 videos during the lecture course: 11/16

3.1.4. *Total number of hits and average audience retention:* The MATH2101 videos received 693 hits with an average of 7% of each video being watched.

The MATH2401 videos received 3,341 hits with an average of 31.7% of each video being watched.

3.2. **Was Lecturecast or Youtube a better medium for disseminating the videos?** The MATH2101 videos were distributed on Lecturecast and the MATH2401 videos were distributed on Youtube. The latter came about because I experienced difficulties uploading large videos to Lecturecast and wanted to make the videos available to students as quickly as possible.

I put less care and attention into the MATH2101 videos: I did not put a summary of content on Lecturecast because I was not the lecturer and didn't have time to watch the whole video; there was also a longer delay between each actual lecture and its online availability (due to complications with Lecturecast). This was probably a major contributing factor to the comparatively low usage, especially considering that usage statistics indicated a spike of usage just before homework deadlines (not possible if the delay is too long). Also, while the Youtube playlist was "private" (i.e. not indexed by search engines) there is no guarantee that the Youtube statistics come exclusively from UCL students (especially as I put up links to some of the early videos on my blog). However, patterns of usage (correlation of viewing spikes with homework deadlines and exams) seem to indicate that the majority of the Youtube hits were from genuine MATH2401 students.

Even taking the above considerations into account, the quoted statistics seem to indicate a strong preference for Youtube over Lecturecast as a dissemination platform. This was backed up to a small extent by the results of two Moodle surveys I conducted: in the first only 11 responses were received, but 8 of these displayed a preference for Youtube; in the second survey, one of the comments left explicitly stated "Putting them all on Youtube would be much better". There were also usability issues for the lecturer in terms of uploading videos to Lecturecast¹.

It is clear that UCL's system needs development if it wants to be a viable alternative to the lecturer just sticking it on Youtube.

3.3. **Is there any evidence to support the idea that international students make use of the videos more than their home student counterparts?** This question can be answered using the Lecturecast data for MATH2101, which gives individual students' viewing statistics that can be cross-referenced with UCL's student database Portico to find out if a student is international or not. For MATH2101, 50% of students were international, 50% were home students.

Number of (non-resit) students using the MATH2101 videos

¹The primary issues were: cross-operating system incompatibility of the Lecturecast upload system; length of upload time; logging the user out mid-upload; requiring extra compression, so compression took 4 hours per video; arduous data entry and editing (requiring many clicks through a slow website); only being able to upload one file at a time.

- 31% of international students
- 48% of home students
- (40% of all students)

Average number of views (amongst those who viewed anything)

- 6.9 (international)
- 9.0 (home)

Contrary to my hypothesis, fewer international students used the videos and those that used them viewed them less (on average) than their home-student counterparts. There were some notable exceptions to this rule: the single user with the most (77) views was an international student.

3.4. Resit students. Another interesting group of students are those who retook the course from the previous year (and therefore did not attend lectures this year). Half of these students viewed videos and the average number of views amongst those who watched anything was 10.7. It seems that video lectures can be extremely useful for these students. One of the responses to the post-exam Moodle survey read: “having to retake these modules without attending lectures, these videos made my revision much easier as i could refer to the videos whenever I did not understand a concept and see how the examples were solved in detail.”

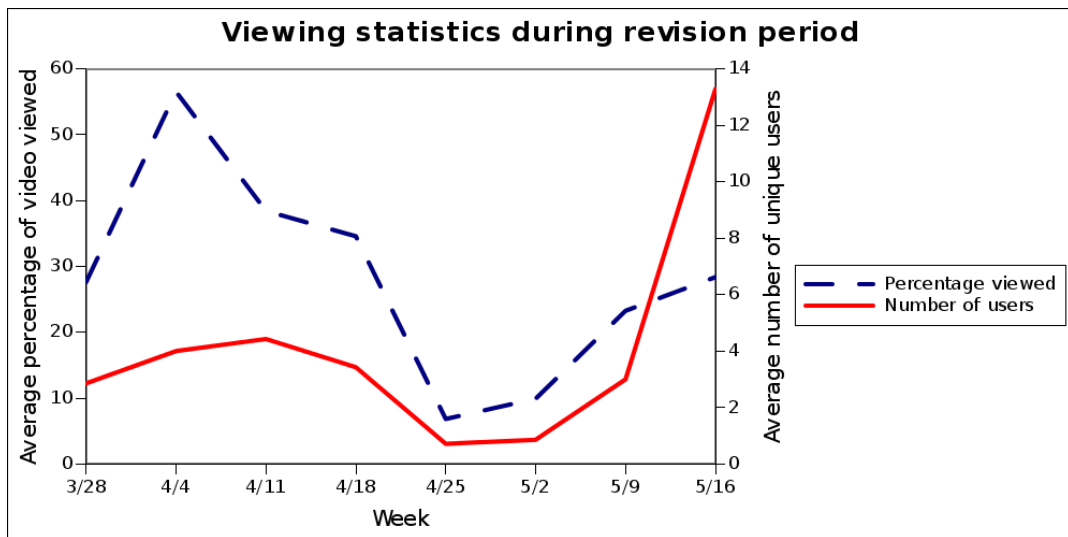
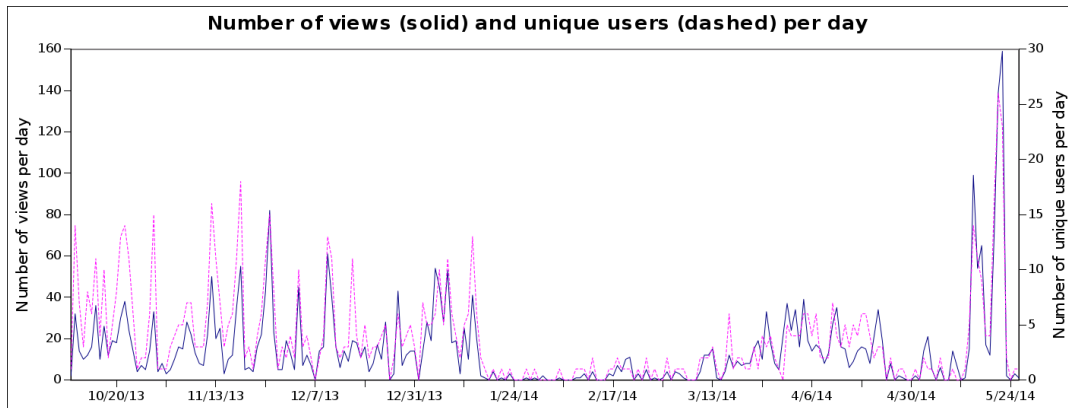
3.5. What were the patterns in usage and what does this tell us about how the students were using the videos to complement their other learning strategies?

3.5.1. *MATH2401*: On average, each view lasted 31.7% or 12.5 minutes of a video (these two statistics are not directly related as different videos were of different lengths).

Which 12.5 minutes are people watching? Are students watching 12.5 minutes, getting bored and stopping, or are they clicking to the segments of lecture that most interest them and ignoring the rest? Youtube does not provide this information, however...

3.5.2. *MATH2101*: On Lecturecast there are “usage heat-maps” available which allow me to see which parts of lectures were viewed most often. I am not sure of the best way to present this information, so I will opt for a very rough rule-of-thumb: if the heat map indicated several areas of heavy usage not all concentrated in the first ten minutes then I will class the video as Well-used, otherwise I will class it as Badly-used. 72% of *MATH2101* videos were Well-used. It seems that students who were using the videos were using them as an effective complement to their lectures, reviewing a subset of material as they deemed necessary.

3.6. How can we make our lecture videos more useful? One particularly good suggestion made on the Moodle forum by a *MATH2401* student was to put a commentary below the video indicating what was covered at what point in the lecture. I did this for a number of the early *MATH2401* videos (on Youtube it is possible to put links to minute XX:XX in the video), but didn't have time to keep this up as term went on. Comparing the completion percentage of videos with and without linked commentaries shows that students watched slightly less of a video with a linked commentary (but only by 2.6 percentage points on average); the hope is that what they watched was more useful to them, but this is difficult to tell from the data collected.



Another suggestion was to film problem classes in addition to lectures. This would bypass the logistical issue of lecturers switching the problem sessions and lectures (all would be filmed) at the cost of an extra hour's filming per course per week.

3.7. Viewing statistics over time.

3.7.1. *How were the videos used during the course?* Youtube statistics for MATH2401 indicate that the heaviest usage followed a weekly cycle during the lecture course: there was a spike every week the day before homework was due. The average number of views on "homework nights" was 3.7 times that of the average number of views on non-homework nights. I am surprised by this, because the problem sets I gave out should definitely have taken longer than one night to do properly. Youtube's estimate of the number of unique users responsible for these spikes is on average 13.7 as compared to 4.8 on a non-homework night. I pointed out already that the longer delay between MATH2101 lectures and availability of videos meant that a similar spike could not occur for that course (the videos were not always posted before the relevant homework deadlines).

3.7.2. *How were videos used in the lead-up to exams?* If we plot the average percentage of each video viewed each week in the weeks between the start of the Easter holidays and the week leading up to the exam, we see very distinctly how students were using the resource: early on there are fewer views of longer chunks of video; as other exams loom, usage drops

off until the week of the exam when we see a larger number of views of slightly smaller (but still substantial) chunks of video.

There is an enormous spike of 159 views the day before the exam. This was to be expected, but again it indicates a certain degree of “cramming” at a point in the revision cycle where I would ordinarily expect students to be focusing on past papers rather than lecture content. On the other hand, it seems that only 23 unique users were responsible for this spike, which is only 13% of the students taking the course.

3.8. Was there an effect on lecture attendance? The MATH2101 lecturer noted a marked drop in attendance.

“in class of 191 students: 137 out of 150 copies of coursework picked, 110 copies picked up two days ago! 116 the next week. last homework taken by 101 students only.”

The same phenomenon was observed in MATH2401, to an even greater extent (I sometimes counted only 60 students in attendance). In the latter case it is not clear if this was due to availability of filmed lectures; equally it could have been due to the availability of online lecture notes.

3.9. Is it worth pursuing video lecture-capture or another alternative to Lecturecast’s recording system? The conclusions above seem to indicate that while many of the students did not use the videos, a small but significant number of students found the videos very useful, both during the course and in the lead-up to exams. Contrary to my hypothesis, home students made more use of the videos than international students on average.

The logistics of filming are as follows.

3.9.1. Staff costs: To hire students to film one 30-hour lecture course plus 8 problem classes, paid at the standard rate UCL pays all student workers (at least for the academic year 2013-2014), costs £515. If we were scaling this system to cover all our core first and second year modules, this would amount to £10,815 per year.

This does not include staff costs for processing and uploading video files: I gave my time freely to this project because I wanted to see the results, but it was a significant effort and if it were to be implemented on a larger scale it would be infeasible for lecturers to do the compression, storage and uploading. There are obvious benefits of having a centralised system like Lecturecast with professionals to handle issues like storage and compression of video files and the ideal solution would be to integrate with their system. For sake of argument let us assume that we set up an independent system and estimate these staff costs at 10% of a Grade 4 support staff-member’s time (this would involve managing the equipment, collecting, compressing and uploading videos): this would amount to at least £2,000/year.

3.9.2. Equipment costs: Due to technical issues (charging batteries and downloading video files from SD cards) it would be necessary for each course to have its own 16GB SD card and battery pack for the camera (moreover, the batteries we used didn’t quite last for the duration of a two-hour lecture). I am not sure what the expected lifetime would be of a 16GB SD card used to film 30 hours of lectures: I burned up one out of two. Plugging in the microphone base is also a restriction in some older lecture theatres which are not well-equipped with electrical sockets in the optimal places to locate cameras for filming. If we were scaling this project

up to film more lectures, I estimate that each camera would need an hour off in between lectures (to give camera operators time to move it between lecture theatres and to make sure that the new batteries/SD card were collected). Taking into account timings of lectures, this would probably mean that one camera could service two or three courses at most. We would therefore need five cameras (estimate £600 each) to service all first and second year modules. Given the issues with microphone quality highlighted by the trial, this would also be something we would need to invest in (estimate £100 each).

4. Summary and conclusion

The MATH2101 videos received 693 hits with an average of 7% of each video being watched. The MATH2401 videos received 3,341 hits with an average of 31.7% of each video being watched. For MATH2101, this usage was mostly amongst a small number (15%) of students with 62% of students not using the videos at all. There was no indication that international students used the videos more than home students (if anything, the opposite was true). Usage of MATH2401 videos was strongly correlated with homework deadlines during termtime.

Based on Lecturecast heat-usage maps, students were using the videos effectively to support their learning (selectively viewing relevant content). A small number of MATH2401 students used the videos extensively over Easter, with a larger number using the videos in shorter bursts in the final days before the exam. There was a marked drop in attendance noted in both lecture courses.

Purchasing the technology would involve an initial outlay of approximately £3,500, filming/data management costs would be at least £12,815/year (increasing with inflation) to service all first and second year modules. This would be a significant outlay for the department, but one might say “not compared to the annual tuition fee currently paid by just one student benefitting from the scheme”. On the other hand, it might be more efficient and cost-effective to install a high-resolution system for capturing lectures in all major lecture theatres.

There remain questions about whether it is worth implementing. The usage statistics indicate that it might be very useful for a small number of students. This is reflected in the Moodle surveys I conducted: there were a very small number of largely positive responses. I will conclude by letting these students have their voice.

5. Student comments

- The idea of recording the lectures is excellent - given the fast pace at which Dr Evans explains material at times, it is always useful to be able to go back home, re-watch and re-reflect on what he taught.
- I agree that recording them is really useful but also find the distorted sound very annoying and sometimes hard to understand. However, the picture quality of the video is perfect.
- I'm interested to know how long the lectures will be available for as it would be useful to revise from for the summer exams. This would be made better if there was additional information or tags that indicated the content of the lecture if there was a specific topic that you were trying to revise. Perhaps the time into the video where a new topic is started could be listed?

- The videos are a good way of going over something you didn't have time to dwell on in lectures, and are explained by the lecturer which makes it easy to grasp when watching it back. Videos and good electronic notes also mean you can listen to the lecturer more as opposed to just copying what they are writing on the board for the whole time.
- Very useful for reviewing material or catch up with missing lectures due to inevident causes
- amazing to recap material! please keep this for next years students
- I will watch a lot more over the holidays when I have more time
- Putting them all on Youtube would be much better, eg armin the axolotl
- I didn't use them during revision, but I found them really useful during the term
- Great to have a reference if something in my notes looked wrong. Also was very useful the day I was ill to be able to see the lecture for myself.
- Was a useful tool to have. However quality and camera handling could improve.
- Please expand LectureCast to cover other modules as well because it is unbelievably useful.
- Would be better if the recording hardware that are already pre-installed in lecture theatres were used as opposed to hand held devices. With regards to Analysis 3, there were many lectures missing as they had been scheduled as Problem Classes, however Dr. Petridis changed these on a weekly basis and there were therefore gaps in the material - in terms of usefulness of lectures vs problem classes, all were equally useful and would have been good if they were all recorded. Likewise with the problem classes for Methods.
- having to retake these modules without attending lectures, these videos made my revision much easier as i could refer to the videos whenever I did not understand a concept and see how the examples were solved in detail.
- The videos were extremely useful during revision and for reinforcing what i had learnt throughout the course

6. Thanks

Thanks to Yiannis Petridis for allowing his MATH2101 lectures to be filmed as part of this project.

Thanks to the E-Learning team and their E-Learning Development Grants which allow us to test out new ideas which would otherwise languish as unfunded dreams.

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Thanks to Rob Lee for helping to solve my difficulties with uploading to Lecturecast.

Thanks to June Hedges and Rod Digges for clarifying UCL copyright issues when I wanted to go ahead with uploading to Youtube.

Thanks most of all to the students of MATH2101 and MATH2401 for their input and feedback.