AC 2012-4577: EFFECTS OF LECTURE CAPTURE ON A LARGE FIRST-YEAR ENGINEERING COURSE

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Effects of lecture capture on a large first year engineering course

Introduction

Our first year engineering classrooms are undergoing many obvious changes, such as increasing class sizes, growing international student body, greater diversity in student background, and the increasingly ubiquitous nature of technology both in and outside of the classroom. Less obvious, but no less important, changes are also taking place in how our students access information, take notes, study, and interact with their instructors and peers. The study presented in this paper explores the use and impact of a relatively new education technology, audio - slide lecture capture, which was implemented in a large first year engineering class in an effort to address these changes. While there are a number of existing studies on lecture capture that address student attendance concerns this study also details the difficulties of implementing a lecture capture system in a large, first year engineering course, both from a technology and an instructor perspective. We use a classroom response system and on-line tracking to measure lecture attendance and the behavior of students in terms of when they access the captured material.

Lecture capture is the process of recording a lecture for the purpose of making the content available asynchronously, i.e. at a later time. In our course the system captures audio data and synchronizes it with a video recording of the data projected on the screen. In our case this included PowerPoint slides, OneNote pages, document cameras, videos, and web surfing, but this process is compatible with any data that is inputted into a data projector.

There are a number of studies in the literature that examine the use of lecture capture, particularly in engineering courses. For the most part the goal of these studies is to investigate whether lecture capture diminishes lecture attendance, and whether students make use of the captured material. For example, Davis et al. (2009) examined the use of a lecture capture system in several courses. They used surveys of students to determine the effectiveness of this system. Like many studies in this area, they found that the lecture capture system had little effect on attendance. In addition, the students reported using the captured material, and they reported that they found it helpful. Toppin (2011) found similar results, but also found that many students complained that the captured material was inconvenient to access. This may have been a function of the technology that was being used. Toppin went a step further by surveying the faculty members who used lecture capture. Although this was a small number, they generally responded positively to the experience and the perceived value for their students.

Von Konsky et al. (2009) compiled quantitative data to augment the results from student surveys to investigate the impact of lecture capture. They found that there was some correlation between the number of times a student accessed the recorded material and their final grade in the course. However, they also found that there was a significant variation in usage among the top students.

This suggested to the researchers that top students make use of individualized learning strategies that are effective and diverse. Generally, some students find the captured material to be very useful for their learning, and other students can achieve substantial learning using other strategies. Von Konsky et al. point out that this is exactly the type of flexible learning system that we should be striving for as educators.

In the study presented here we look at both the number of times the students access the system and the timing of that access. In particular, how the timing of the access corresponded to the assignments and tests in the course. In addition we consider carefully the technical issues that we faced in implementing this type of system.

The lecture capture system examined in this study was recently adopted in a two-term, first year engineering design course. One of the distinguishing features of this course is its large enrolment; 1000+ students. The course consists of three hours of lectures per week, conducted in a single section. In addition the students have two hours per week in tutorial where they work on a fictitious design project in the fall and a service learning design project in the spring. The course is taken by students in eight different disciplines and students in our general engineering freshman program.

The National Survey of Student Engagement (2006) demographic data for our institution indicates that 68% of our student body identifies as a visible minority, and 27% are international students. There is a fairly typical 74%/26% male/female split. Over half (54%) of our students live farther than walking distance from campus, with 47% of those students indicating that their commute is greater than 40 minutes each way. Public transit is the most common means of commuting. Arguably, these students are already faced with a potential hurdle to physically attend lectures; therefore, when using a lecture capture system, it is important to determine whether this process would actually negatively impact student attendance by encouraging students to view the previously recorded lectures in lieu of their physical attendance.

A small, but unique portion of our student body (3%), is enrolled in a special bridging program called the International Foundations Program for students who have met all but the language proficiency entrance requirements for the engineering program. Despite not being admitted to engineering they are allowed to enrol in the course that is the subject of this paper, and no other engineering courses. They receive 20 hours per week of language instruction to develop their language proficiency to a level acceptable for the faculty. Once the bridging program is completed, they receive credit for the course and are admitted as regular students. One of the motivations for the implementation of our lecture capture system was to provide additional support for ESL students such as these students. The captured lectures enable these students to review the lecture material at their own pace removing some of the obstacles for students struggling with the English language.

Methodology – Service Environment

Course lectures take place in a large 1750 seat theater that has been retrofitted to serve part-time as a lecture hall (see Figure 1). There are two small and one large projection screens at the front of the room along with an elevated stage and podium (see Figure 2).

Figure 1 –View of two thirds of the studied course student population

Figure 2 – Reference view of the stage and projection screens, (not lecture capture view)

The podium mounted teaching station consists of a Personal Computer (PC) and monitor running Windows XP with an Ethernet internet connection, an additional Ethernet internet connection, a

VGA input, 3.5 mm audio input, wireless microphone outputting to the lecture hall speakers and a 3.5 mm audio output, and a touch screen control system.

Methodology – Background

The lecture capture system was adopted as a natural extension of an audio-only capture system that was moved from pilot status to fully implementation in the 2009-2010 academic year. The audio-only system was implemented to support student review of the lectures, both for study purposes and to assist English as a Second Language (ESL). The audio-only lecture recordings were regularly used by a small group of students, but according to website tracking and anecdotal evidence, this previous system was not adopted by a significant portion of the students.

Extending the audio-only recordings to full lecture capture was thought by the course teaching team to be one way to increase this usage. However, some members of the teaching team expressed concerns over possible adverse effects on student behaviour, such as decreased lecture attendance and lower quality note taking. Existing literature states that there are no such adverse effects (actually the opposite) with several benefits reported; however, teaching team concerns persisted, due to the perception that our student body is unique relative to those reported on in the literature (e.g. commuting time). There was concern, for example, that first year students may not have the experience to judge the value of making the effort to attend a live lecture that includes interactive teaching. The study described in this paper was motivated by these concerns.

Methodology - Equipment

Two configurations were used by the five instructors for the course to accommodate different teaching styles. Configuration #1 consisted of running Camtasia Relay (version 1.2.0.69) lecture capture software installed on the teaching station computer. The only initial modification required to install this configuration was to split the wireless microphone signal and input it into the podium computer. This modification was only required once during the initial set up. Configuration #2 consisted of running Camtasia Relay 1.2.0.69 off the instructor's personal laptop. Each time this configuration was used the wireless microphone 3.5 mm output was plugged into the laptop microphone input, and the laptop VGA output was connected to the VGA input.

With either configuration at the start of the lecture the instructor ran the Camtasia Relay program (either on the podium computer or the laptop). The instructor was then prompted to log into the centrally maintained *My Media* server. After logging in and an intentional three second delay, Camtasia Relay began recording video of everything on the computer screen and everything coming from the wireless microphone. After lecture, the recording was halted in Camtasia Relay. The instructor was then prompted to trim either the beginning and/or end of the lecture. This

allowed us to start the recordings early, before lecture had formally begun, to avoid delaying the lecture start-time without concern for producing videos with dead space. This simple editing required three mouse clicks and approximately 5 seconds for someone experienced with the software. The final stage, uploading of the video to the *My Media* server, was automated. If the computer had an internet connection the upload began immediately. If, however, there was no internet connection, then the software would wait in the background and would automatically begin upload when an internet connection was achieved. This level of automation was valuable for ensuring consistent lecture capture, especially important as our lecturers typically need to leave the classroom promptly at the end of lecture to vacate the space for the next lecture.

When the video was finished uploading, it was processed by the *My Media* server and a link was emailed to the instructor. The instructor would follow the link to review the video to ensure it was acceptable. If they were satisfied, they would then set the video either to streaming-only or download and streaming and then make the video available to those with access to the university's domain or to the general public. After being made available, a permanent hyperlink was generated to access the video. This link was then posted on our course management software, Blackboard. Since this was a link only, the video being stored on a central server maintained by the university library, there were no concerns about exceeding Blackboard storage limits with large video files.

Methodology – Problems encountered

This configuration, even with a solid theoretical design, proved to be problematic. Configuration #1, using the podium computer, proved to be the most robust with no difficulties reported except for one occurrence of human error. Two of the instructors make use of Tablet PCs for lectures, and so using the podium computer was not an option for them. We proceeded with Configuration #2, which resulted in many issues. On one older tablet PC, Camtasia Relay would simply not install. No amount of technology support could get the software to run. The only work-around was for that instructor to borrow a tablet PC from the Instructional Technology Office for each lecture.

On the second tablet PC, a brand new model, Camtasia Relay appeared to install with no issues. When recordings were made on this computer, generally there were no issues; however the number of times that recordings were lost was enough to make us doubt the reliability of the software and to seek other options. One failed recording occurred when a Skype audio session was attempted on this tablet PC during lecture. Camtasia Relay crashed leaving no sign of the pre-Skype recording; furthermore, Camtasia Relay would not record again until after the computer was rebooted (not an option in the middle of lecture). Another recording failure occurred in which the video was recorded without audio. This may have been human error, but we could not determine the exact cause. Finally, and worst of all, there were unpredictable

failures with no obvious causes and therefore no means to predict or avoid them. These failures occurred only a handful of times, but recordings were sufficiently unreliable that we were forced to revert to using our previous audio-only recording system as a backup.

A third instructor's personal laptop was a new Macbook Air running the latest OSX 10.7. Though Camtasia Relay has a MAC version, and it installed without any problem, it was discovered that the current version of Camtasia Relay was not compatible. It would only record audio without video. There was no resolution for this and the instructor was forced to use the podium computer for lectures.

The online media server used to host the lecture videos was also suspected of causing issues. Initially there were issues caused by video resolutions generated when the video was processed on the server. These issues were quickly resolved by the server administrators and did not reappear after the initial few videos. The server was also suspected of "losing" videos later in the term, but informal testing pointed to the interface between the *My Media* server and Camtasia Relay as the issue, not the server itself.

Methodology – Alternative configurations

The challenges faced in the first term of this initiative were significant enough to force the teaching team to seek alternative technology. The first alternative explored was Camtasia Studio. Though produced by the same company as Camtasia Relay, Camtasia Studio is their full-featured version of the software. The software was installed on one tablet and appeared to function more reliably than the Relay version. Still, this option was dismissed since a separate license would have been required for each computer used, and the university did not have a site license whereas they did for the Relay version.

The method selected for future piloting is the Echo 360 hardware/software solution. This configuration includes a hardware box that includes a hard drive and video and audio inputs. This box will be installed in the teaching station between the projector source (laptop or podium computer) and the projector. The wireless microphone will output directly into this hardware box. The lecture once captured is uploaded via the network to a custom Echo 360 media server. Preliminary trials of this configuring are promising with additional data being collected over the winter 2012 term.

Results

Results for two types of lecture capture are discussed below. First Full Length Lectures captured in the classroom, and second Mini-Lectures captured outside of the classroom.

Full Length Lectures

The evaluation of our lecture capture system involved the tracking of lecture attendance, see Figure 3. A fair approximation of lecture attendance is regularly collected through the use of a classroom response system. Note that the low attendance recorded for the first two lectures is because students were still in the process of purchasing their course materials, in particular the iclickers they need in order to engage with the classroom response system. This attendance data has been superimposed on the implementation timeline of lecture capture in the course. This has allowed for a correlation study between student attendance in lectures from the previous year, while the audio-only system was in place, to student attendance this year after the upgrade to audio-slide capture.

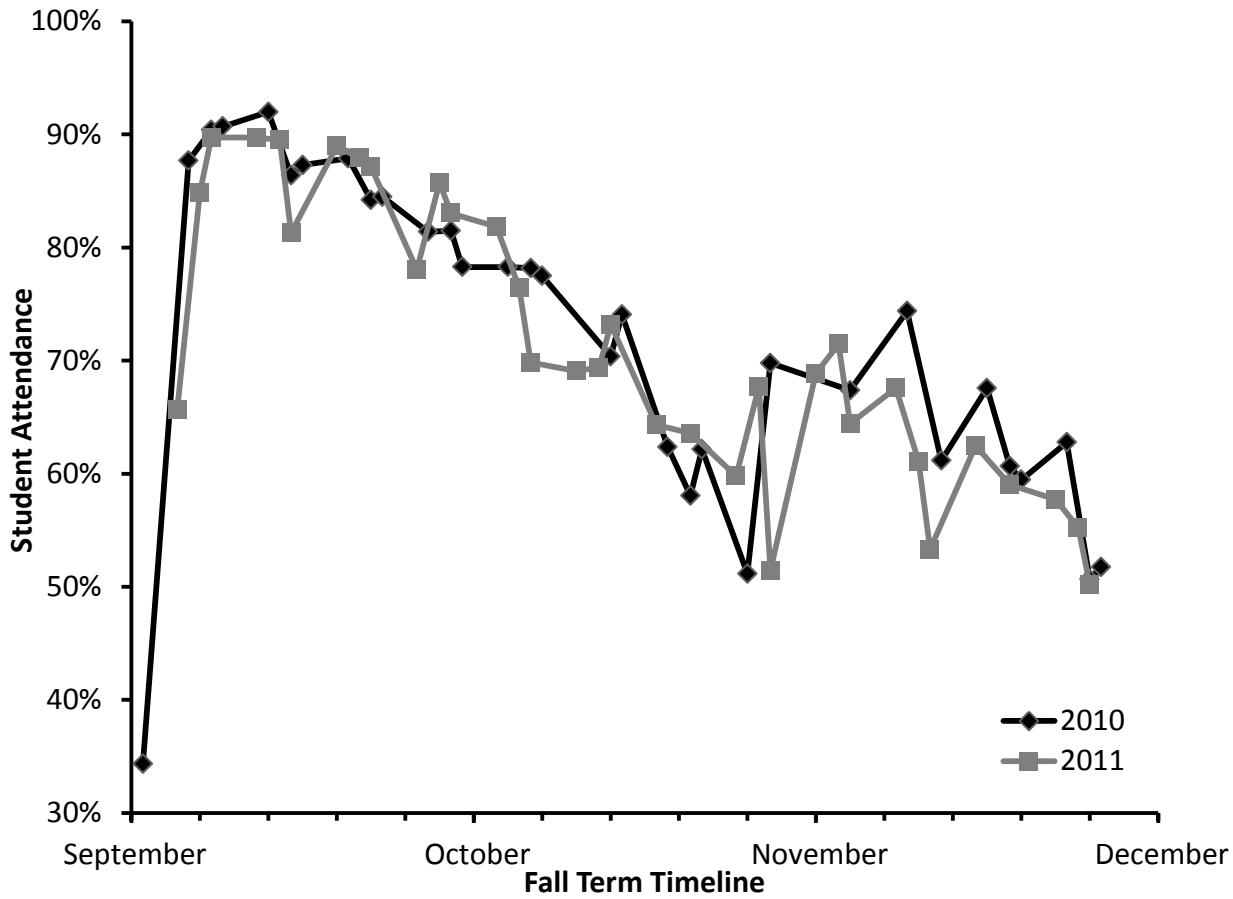

Figure 3 - Student lecture attendance for the fall term - Audio-only recordings (2010) and with full lecture capture (2011)

The pattern of attendance for Fall 2011, when full video captures were posted, almost exactly mirrors the pattern of Fall 2010, when students could only access audio recordings of lectures. However, one source of error may be the reliability of the capture program. It may be that because some lectures were lost, either in part or as a whole, students did not develop the confidence that would have allowed them to stay away from lecture. In addition, a tiny part of the term grade is dependent on the student's answers to questions posed during lecture

(documented by the classroom response system). Small though that mark is, it may be a sufficient incentive for attendance, whether or not lectures are available online. Further study is required on the particular uses and values of captured lectures for students who both attend lecture and access lectures later.

In addition, through tracking of the website where our recorded lectures are posted, we were able to collect data on the number, frequency, and timing of student downloads and streaming of the lecture recordings, see Figure 4. The analysis of this data gives insight into the popularity of student usage of the lecture recordings. Note that the vertical dashed lines on the graph represent points of assessment: assignment due dates and tests. The usage is tracked for each individual lecture by date; e.g. the line for 13-Sep represents when the students accessed the lecture that was captured on September 13.

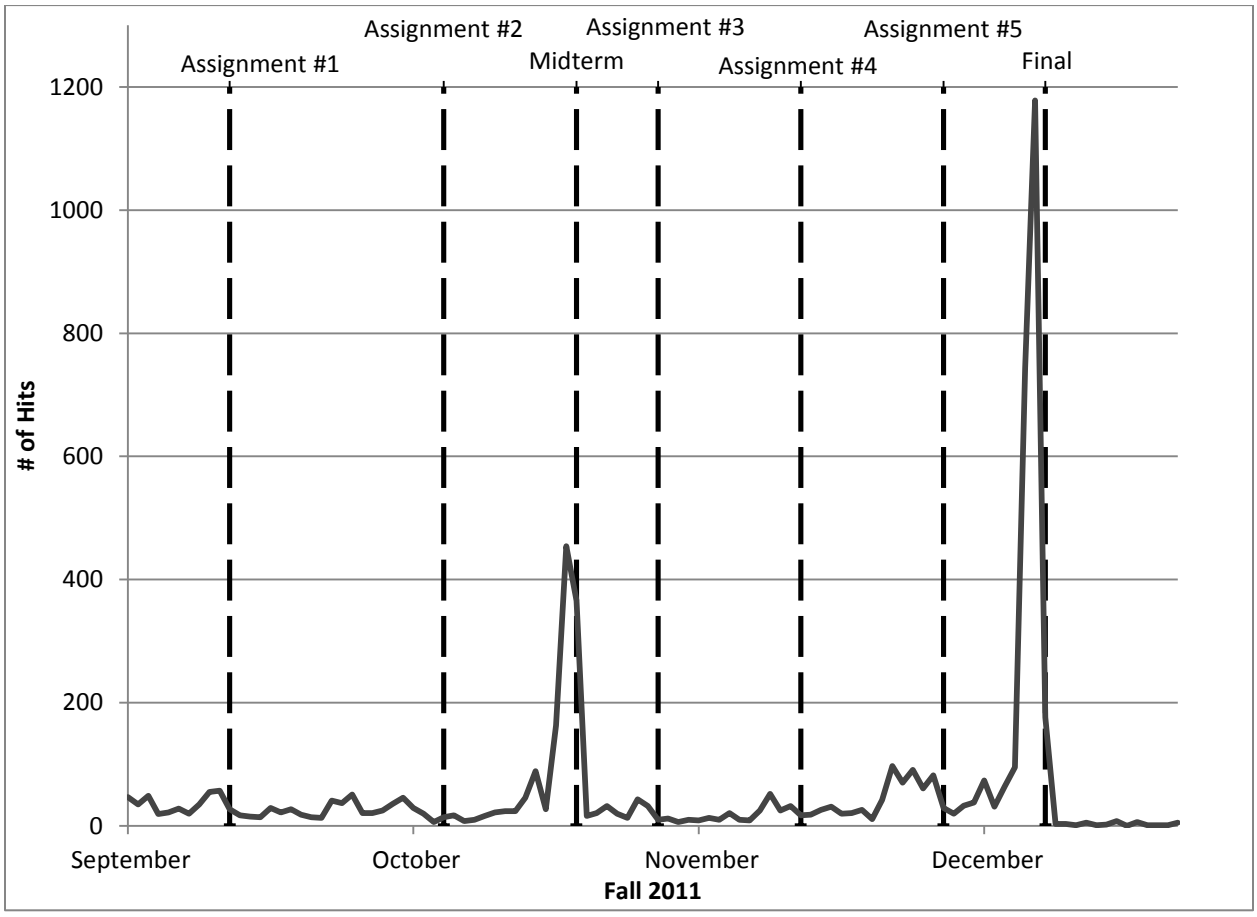

Figure 4 - Lecture Capture Accesses - Classroom Captures

Mini-Lectures

The infrastructure for the lecture capture also allowed for lectures to be recorded outside of standard lecture periods. The teaching team used this technology to post 5-25 minute-long online-only mini-lectures as additional resources for students. These supplemental mini-lectures

included topics that students were previously expected to learn independently, using primarily text-based resources. However, the online environment allowed for the development of lectures that could go into detail on particular aspects of assignment instructions or models. They eliminated both the constraint of fitting all instructional material into a tight schedule shared by three lecturers and the constraint of student interest, which easily lags when communication issues are dealt with in depth. Students who are interested will watch the videos for as long as their interest holds out, without the distraction of other, uninterested students nearby.

Using the Camtasia program in the relaxed atmosphere of the office or on the home computer is also much more comfortable than in the lecture hall. In addition, the tone of the lectures is more intimate and personal. While the overall videos cannot be edited internally, they tend to be short and can easily be redone to remediate major problems. Camtasia Relay has an add-in for PowerPoint and this greatly facilitates the process of creating a video and the quality of the video itself. However, when used with other programs which do not have an add-in, the quality is far inferior to that of the PowerPoint presentation.

Using the same website tracking data sources used in the lecture capture portion of this study, student usage and impact of these additional resources on their learning and student experience have been analysed.

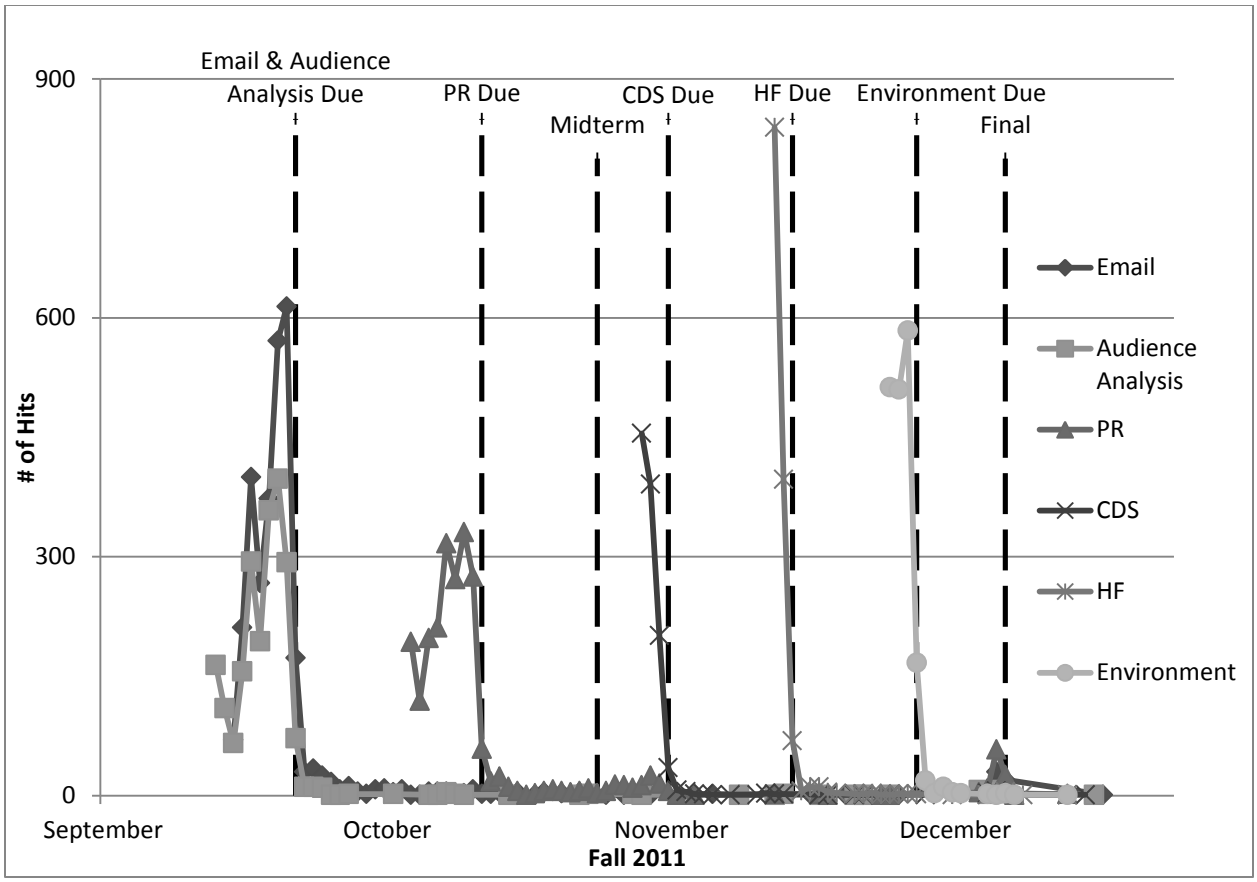

Figure 5 – Model Assignment Videos Accesses

Conclusion

An initial motivation of the study presented here was to alleviate concerns that providing students with video lecture capture would adversely affect attendance. Our current data correlates with other studies that show that availability of online lectures has little effect on attendance patterns. Thus, if the lectures are not a substitute for in person attendance, but rather an augmentation of it, further study is needed in determining how to optimize the functions that they are currently providing, as part of what Von Konsky et al describe as a desirable flexible learning system.

Data on the number of times the video lecture captures were accessed shows a distinct, but not unexpected, pattern with peaks of varying amplitude just prior to each major milestone in the course. The days leading up to the final exam showed the highest level of access with the midterm following a distant second place.

The usage of the model assignment videos follows the same pattern of peaks prior to major assignment deliverables; however unlike the lecture captures there was little usage prior to the

midterm and final exam. This could indicate that students associated lecture content with the examinations and not the assignment material. This is despite being instructed that all such material was examinable and at multiple assignment specific questions being posed on the midterm. However, it is difficult to be conclusive since the usage data is for the number of accesses to the video files, both streaming and download accesses. This means that a student may have downloaded the video files to their personal device earlier in the term and was able to view the material again without triggering an additional data point. This complication could have been avoided by only allowing the streaming video; however the decision was made to allow both streaming and download to better serve the students' need to view the videos offline, particularly while commuting.

Instructor comments on the implementation of lecture capture was mixed. There was a strong sentiment of frustration at the unreliability of the system and the resultant additional workload. However when the system did work there were high praises for benefits such support for ESL students and the separation of mundane topics from the limited time for interaction in the classroom. The general consensus was that lecture capture was worth continuing, however a new system needed to be developed.

The implementation of lecture capture proved to be a far greater technical challenge than originally anticipated. The workload for the teaching team was increased, especially given the multiple failures of the technology. Were these challenges clear at the onset it is likely that lecture capture would have still been implemented, however only after a longer testing period. That being said the authors continue to be strong supporters of lecture capture in general and will continue their work using a new lecture capture system.

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