Lecture Capture in Engineering Classes: Bridging Gaps and Enhancing Learning

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ABSTRACT
This paper explores the use of lecture capture in Engineering classes to provide students with the opportunity to enhance their understanding of the course content. Students were asked to provide feedback on what they perceive the benefits and the drawbacks of lecture capture to be. The results show that the students consider lecture capture an effective tool to help them succeed in the course. The videos are available to them 24 hours a day, seven days a week thus allowing students to bridge the gap between what they have understood in the formal class setting and what they are able to better understand after reviewing the videos in a more informal, relaxed environment. In addition, most of the students indicated that the availability of the videos did not encourage them to skip or miss any classes. The main drawback was associated with technical difficulties which resulted in some wasted time.

Keywords
Lecture capture, Learner autonomy, Technology in higher education, Engineering

Introduction

Educause describes lecture capture as an “umbrella term describing any technology that allows instructors to record what happens in their classrooms and make it available digitally” (2008, n.p.) for the students to view after the class. According to Davis, Connolly and Linfield, “lecture capture has the potential to alter the way in which face-to-face teaching is delivered and received” (2011, p. 11). The recording of classes can be a simple video recording, but more often special software and / or hardware is needed so that the professor, the whiteboard and any other materials used by the professor, for example, PowerPoint, are recorded clearly. Well-known universities such as MIT and UC Berkeley were pioneers in lecture capture and webcasting (http://ocw.mit.edu/courses/, http://webcast.berkeley.edu/).

Several recent studies have looked at the advantages and disadvantages of lecture capture from both the lecturers’ and the students’ points of view (Davis, Connolly and Linfield, 2010, Secker, Bond and Grussendorf, 2010, Toppin, 2011). Some of the benefits of including lecture capture are directly related to good teaching practice, i.e., fostering student engagement, appealing to students’ interests, offering multiple opportunities to access content and providing opportunities for learners to learn at their own pace. With lecture capture, students can view the archived lectures at their convenience and watch them as many times as they want or need to. The same can be said if the PowerPoint slides or other class notes are made available to the students, but lecture capture allows for the student to once again hear the Professor’s explanation and any class discussion of the content that occurred in class. The ability to both hear and see the information has been shown to help students retain more information and ultimately improve their class performance (Traphagan, Kucsera and Kishi, 2010). In addition, students can freeze the frame, rewind and hear the explanation many times until they feel they have understood the material.

One of the concerns expressed by faculty regarding the use of lecture capture is the possible impact on class attendance. Traphagan, Kucsera and Kishi (2010) looked specifically at this issue. They did find that the “availability of webcasts negatively impacted student attendance” (p. 19), however, the access to the video lectures and resulting better performance by the students “appeared to nullify the negative effects absenteeism” (p. 19) could have had. Toppin found in his study that there was no effect on student absenteeism and “actually increased attendance for a few students” (p. 392-393). In addition, in their review of recent lecture capture literature Secker, Bond and Grussendorf noted that “recording lectures has a minimal impact on students’ attendance” (n.p.).

Other concerns on the part of faculty include the extra work involved as well as privacy and copyright issues. Editing and publishing the videos can be time consuming. As noted by Educause, “a complicating element of lecture capture is ambiguity over who … owns the intellectual property once the recording has been made” (2008).

Students, for the most part, report that they benefit from having access to the video lectures. The benefits include higher grades, more active involvement in the class and engagement with the course material. In Toppin’s study the
“students valued VLC [Video Lecture Capture] as a supplement to their traditional lecture format and affirmed that it helped them to understand concepts taught in the courses” (p. 391). In addition, as noted by Zhu and Bergom, “students report that they appreciate the flexibility of accessing [videos] anywhere and anytime” (2010, p. 3). Students also state that having the video lectures available to them helped them focus more on the class because “they took fewer notes during class and were able to pay closer attention to the lecture” (Zhu and Bergom, 2010, p. 2).

Brooks, Epp, Logan and Greer (2011) looked specifically at how students were using lecture capture. They found evidence for four types of learners:
1. Minimal activity learners: students try watching the lectures but do not use it on a regular basis.
2. High activity learners: students may not watch all of the lectures but view some of the content at least once a week.
3. Deferred learners: students do not watch the videos until the end of the semester.
4. Just-in-time learners: students view the lectures only around midterm and exam time.

D’Angelo and Woosley (2007) observed that at the time of their study “students’ perceptions of technology use have not received widespread attention” (p. 464). Four years later, Brooks, Epp, Logan and Greer (2011) note that “very few studies have been done on the ways students use lecture capture technology to assist in their learning” (n.p.). This study, undertaken at the American University of Sharjah in UAE, looks at both of these issues. The study sought to answer the following three research questions:
- What benefits do students feel they gain from the webcast lectures?
- What drawbacks do the students see with including webcast lectures?
- How often are students viewing the lectures?

In the rest of this paper, we first offer a background to the study, describe the different technologies used, benefits of each technology, and some of the problems encountered. We then describe the data collection vehicles used to answer the research questions. After the data analysis, we discuss the findings and conclude with some ideas for further research.

Background to the study

This research was conducted at the American University of Sharjah (AUS) in The United Arab Emirates. AUS is a coeducational private university that was established in 1997. It is a small, Liberal Arts college offering both undergraduate and graduate programs with an approximate student body of 5,500 students from 84 different countries. The College of Engineering is the largest college, constituting almost 40% of the student population in both Graduate and Undergraduate classes.

The initiative of using video capture in Electronics course lectures for electrical and computer engineering students at the American University of Sharjah (AUS) started back in 2009. Since then, it has evolved through two main phases. In the first phase, the whole lecture was captured using a standard video recording facility. In the second phase, an interactive whiteboard technology was used which transformed the standard whiteboard into an interactive whiteboard.

In phase I, the lecture was held in the Engineering auditorium. The auditorium was equipped with a permanent desktop, an overhead projector of type Hitachi CP-X605 and a video reordering system of type Vaddio. The instructor used the computer for presenting PowerPoint lecture slides and relevant videos segments. The Vaddio video camera had a robotic tracking system where the camera was able to dynamically track the instructor’s movements while recording without the need to wear any tracking devices. The sound signal was picked up with a wireless clip microphone of type Shure. The video and sound data was instantaneously transferred to the audio-video recording system located in an adjacent room. This recording system was of type Hitachi. For every lecture, the following tasks were implemented:
- The IT technician ensured that the recording system was switched on and functioning properly
- At the end of each lecture, the IT technician burned a copy of the recorded lecture on DVDs and passed them over to the instructor
The lecture material was then edited and compressed using available software such as MS Movie Maker. Each lecture required up to two hours of editing. After compression, a 75 minute lecture would be compressed down to 400MB of data.

Due to the huge size of the recorded data, the instructor had to pass the edited lecture data to the library to save it on a special server for video streaming purposes.

The library then informed the instructor of the data link to be used in the course website.

The instructor added the link of the lecture video streaming to the course website on Ilearn and informed the students of its availability.

The above procedure was successful in capturing and webcasting all course lectures. Students had the opportunity to view the lecture videos 24 hours seven days a week. Nevertheless, there were some associated practical problems or obstacles faced by the instructor. These problems included:

- Learning curve which resulted in poor sound recording of the first few lectures.
- Poor lighting quality of the lecture hall as depicted in Figure 1.
- Instability of camera while tracking the instructor.
- No zoom function to enhance visibility of what was written on the board.
- The length of time needed for editing videos.
- Long delay from class lecture to videos being available for viewing by students.
- Lack of venue flexibility since the technology needed was only available in the auditorium.

The problems detailed above prompted us to search for an alternative technology with better light quality, venue flexibility and less editing time.

**Lecture capture technology**

There were several systems available in the market to choose from which can meet our requirements. The system which we selected was the eBeam Edge system developed by Luidia Company. It is a Windows-based system with easy to install, purpose specific software aimed at creating an interactive whiteboard environment. This system is an interactive whiteboard technology which transformed the standard whiteboard into an interactive whiteboard. The system setup is detailed in Figure 2. It consists of the standard whiteboard, a data projector, a desktop, the eBeam edge transceiver and a stylus pen. The mobile transceiver which transfers the pen movement to the computer is a very light weight device the size of a board eraser and can be magnetically placed on the side of the white board. The
supporting software offers multiple formats, including jpg, pdf, and PowerPoint. It also enabled us to select different colors, different line thickness, and readily available shapes. The sound was also recorded using wireless microphone and was transferred directly into the computer. The sound system was also activated simultaneously when recording is activated which adds more flexibility to the system. The process of system setup and calibration would take around five minutes. Once the lecture is complete, the data was already saved on the hard disk of the computer. There was no need for any further editing or data compression. A 75 minute lecture would require around 30MB. There was no need of an IT technician to transfer data or send the data to the library for storage on their server. The instructor can easily upload the lecture file to the course website on Ilearn.

There are many advantages of this system over the system we used in phase 1. We managed to reduce the lecture availability time from two days down to two hours. The quality of the video was superior as shown in Figure 3 because the room ambient light level was irrelevant in this case. The amount of data storage was also reduced by a factor of ten. The main disadvantage of this system was the inability of this system to video record the instructor while lecturing. This is a disadvantage because it deprives the student from learning from the body language of the instructor.
Results and Data Analysis

There were 40 students from two Electrical Engineering classes involved in this study. The course, ELE 241, Electronics I, is a required course for all Electrical and Computer Engineering students. 27 male students and 13 female students were involved in this study. Every lecture was captured using the e-beam system described previously and published for students on the AUS course management system, Blackboard. Blackboard is a course management system which allows adding all course elements online including course material, grades, email, announcements, assignments, etc. It also enables the instructor to generate course reports to display all user activity for all areas of the course, as well as activity dates, times and days of the week (http://ondemand.blackboard.com/).

Both qualitative and quantitative data were collected to answer the research questions via three venues: a student survey, focus group interview and the statistics from Blackboard. 38 students filled out the survey and four students, two men and two women, participated in the focus group. The Blackboard statistics represent all 40 students.

To answer the first question, What benefits do students feel they gain from the webcast lectures?, we asked the students in the survey specifically if they thought the videos were helpful in understanding the course material and if they thought the videos would help raise their grades. As show in Figures 4 and 5 below, 37 out of the 38 students either strongly agreed or agreed that the videos were helpful in understanding the course material and 34 out of the 38 thought having access to the videos would raise their course grade.

![Figure 4: Answer to question one in the survey](image)

![Figure 5: Answers to question 2 in the survey](image)
In the open-ended question of the survey, students elaborated upon the benefits of these two main points as illustrated in the following three quotes, none of which have been edited, from students:

The video lectures allowed me to study as efficiently as possible. I am taking the information straight from the professor. It also eliminated the need to ask the professor about small points because you can always go back to the video.

Since it is a class of 1 hour 15 minutes, sometimes it is quite difficult to give our attention throughout the class. If there is something we do not understand in class or miss out, these video lectures come in handy.

In addition to the usefulness of the videos to “fill the gap” if a student gets distracted in class for one reason or another, in the focus group interview, one student mentioned the ability to review to the lectures anytime and anywhere.

Although as reported in the literature, many faculty are concerned that the use of video lectures will encourage students to skip classes, the majority of the students who participated in this study indicated the opposite was true. As shown in Figure 6, when asked if the video lectures prompted them to skip class, seven students were neutral, three students said the videos do prompt them to skip while 28 either agreed or strongly agreed that the video lectures do not prompt them to skip classes.

![Figure 6: Answer to question 3 in the survey.](image)

In the open-ended question one student noted,

This lecture video is very helpful because it will help you understand and see and visualize the lecture. It will not prompt me to skip, because you watch it again to get the things you missed during the class due to daydreaming or so. In addition, it helps you to organize.

Two students noted that they found the videos to be helpful when they missed classes. As they point out, students sometimes have to miss a class for various reasons. In cases such as this, the student has access to the videos to keep him/her from falling behind in the class:

This technology was very helpful when there was reasons I needed to skip the class for (strong reasons) but I did not watch the videos otherwise. And it did not prompt me to skip classes because I care about attendance and attending the class is still better.

The video lectures have definitely helped me a lot. I had missed out on a few critical lectures and was having a really hard time in understanding the concepts and analytical tools in the text. But because of the lectures posted online, I was able to understand; additionally, when I went back to the book
AFTER listening to the lectures, I was able to grasp that information too. So the lectures helped me greatly.

When asked if the students thought other professors should use this technology in their classes, 100% strongly agreed that they should. They gave the following reasons:

Some people have problems with remembering what the professor explained in lecture or don't know exactly how to take notes for it. The video helped me a lot in revising and studying for quizzes and exams. It will be great if all professors use this technology for all courses.

The lecture videos are very useful and it's an advantage to students. Because students can access the lecture video if they have missed some points in class or to understand things if something wasn't clear. All in all, it is a great technology, and it would be better if all instructors used this technology.

I would strongly recommend this technology to be used by other professors in other courses. It is very helpful.

To sum up the answer to our first research question, the data from the survey and the focus group indicated the students could see many benefits but the main reason for viewing them was linked to gaining a better understanding of the material, which, in turn, gave them the possibility of increasing their grades. Another benefit regarding the availability of the video lectures is that for some students, they are freed from taking copious notes in class and can concentrate more in the formal setting of the lecture. Most of the students in this study see having access to the video lectures as another tool to help them learn the course content, not as a replacement for, or an excuse to skip, the lecture.

To answer the second research question, What drawbacks do the students see with including webcast lectures?, we asked the students two questions on the survey, specifically, Were the lecture videos easily accessible? and Did you have any problems while loading the videos? These questions stemmed from previous requests for feedback from students in 2009 and 2010 regarding the use of video lecture capture in their classes. As shown in Figures 7 and 8 below, the majority of the students did not have any problems accessing or loading the video lectures. However, in the open ended question of the survey, students noted that the drawbacks of this system have to do with the time taken from the lecture when there is a technology “glitch”. As one student commented, “Sometimes, it gets stuck and you need to reset it in order to work and takes time from the lecture.” This point was also noted in the focus group interviews as well as the problem of the microphone not being turned on or running out of batteries. Another drawback of including the videos was presented by a male student in the focus group. As he noted, “It’s like seeing the lecture twice. if you didn’t like it the first time you won’t like it the second time!” This aspect of liking the material (and possibly the Professor) and its impact on learning is outside the scope of this research but is an area for further research.

![Figure 7: Answer to question 5 on the survey](image-url)
As noted above, the majority of the students said that having the opportunity to view the lectures did not impact their decision to attend class or not, and, for the most part, the students find the video lectures helpful in their understanding of the class material. However, we wanted to match their perceptions and comments to their actual usage. Thus, to answer the third research question, *How often are students viewing the video lectures?*, we referred to the statistics reports from Blackboard platform. Figure 9 was extracted from one of these reports which shows a pie chart of the overall summary of students’ activity during the first 14 weeks of the semester. Students’ activities included course content, grades, email, etc. The figure shows that the largest activity area representing 72.9% was
occupied by visits to course contents which primarily contain the lecture videos. This is followed by grades which occupied 19%. This result indicates that students mainly visited the course website to watch the course videos.

The daily user activity of the course content is depicted in Figure 10. It shows rhythmic and regular visits by students to the course content. The peaks were observed in the days prior midterm exams. Otherwise, viewing the course contents reached a steady state after week seven of the semester and maintained regular visits to the course contents area. These statistics indeed support students’ claims that the video lectures were helpful in their understanding of the class material.

The answer then, to the third research questions, *How often are students viewing the lectures?* is that the majority of the students are watching the videos every week. The students fall under Brooks, et.al., (2011) high activity learners category.

**Discussion**

The use of video lectures is an example of effective use of technology to promote both formal and informal learning as well as offering students the opportunity to take control of their learning. Research has shown that most people have limited attention spans. However, in a formal learning University environment, a normal class schedule can range from 50 minutes to three hours. If students lose their concentration or get distracted in class, the video lectures will allow them to view the lectures in a less formal setting, any time and any place that is convenient for them. One female student in the focus group said she likes to watch the videos during her commute home from University. Another male student mentioned that he has the video lecture running in the background while he is surfing the web or otherwise using the computer.

The availability of the video lectures also promotes learner autonomy. The use of Blackboard and viewing of the video lectures is something the students have full control over. Although their visits to Blackboard can be tracked, the students involved in this research were not given any incentives, such as bonus points, to do so. In addition, they can watch one part of the lecture as many times as they like and they can skip to any part of the lecture that they wish to review.

For most of the students involved in this study, having access to the video lectures had no impact on their face-to-face class attendance. They took advantage of the formal learning opportunities provided in the lecture and then supplemented their learning by viewing the lectures in their own time. However, for one student, the video lectures may have been the difference between passing and failing the course. When asked by his Professor why he was not attending class he explained that it was not just one class that he was not attending. He found it difficult to concentrate in all classes and stopped attending most of his lectures. He then told the Professor that he could keep up with his class because he had access to the video lectures.
**Conclusion**

D’Angelo and Woosley (2007) found in their study of students’ perceptions of educational technology “that students do not always see that technology benefits their learning” (p. 470). In this study, we have found, however, that most of the participating students could see the benefits of using video lectures. This study, unlike D’Angelo and Woosley’s study, focused on just one use of technology so perhaps the students were better able to focus on the advantages.

To sum up, this investigation shows that the students consider lecture capture an effective tool to help them succeed in the course. In addition, most of the students indicated that the availability of the videos did not encourage them to skip or miss any classes. The main drawback was associated with technical difficulties which resulted in some wasted time. This drawback can be rectified by introducing a preventative maintenance program by the IT department. Further to the data collected from the students’ surveys, the course management system’s reports indicate that students did indeed regularly view the course video contents.

From this research, we have identified two areas that require further investigation. At present, at AUS, there is only one professor using video capture with his classes. The students in this research all noted that they would like all of their professors to include video lectures. If this were to happen, an area of further study would be to once again investigate the students’ attitudes towards the inclusion of video capture in all or most of their classes to see if they value and benefit from the video lectures as much as they do now.

Using video lectures in class requires discipline on the part of professors. They must be willing to not only record each lecture but make sure that each lecture is available to the students in a timely manner. Professors, as well as students, can benefit from the use of video lectures, but as Secker, Bond and Grussendorf (2010), note there are very few studies done focusing on professors’ use of and attitudes towards video lecture. They further note that, “those what do exist tend to focus on what lecturers do not like about lecture capture” (2010, np). Thus, an area of further study would be an investigation into why or why not professors use lecture capture in their classes.

**References**


