Teacher-Scholar: The Journal of the State Comprehensive University

Volume 4 Article 5

January 2012

Testing the Effectiveness of Lecture Capture Technology Using Prior GPA as a Performance Indicator

Michael D. Stroup
Stephen F. Austin State University, MSTROUP@SFASU.EDU

Michael M. Pickard
Stephen F. Austin State University, mpickard@sfasu.edu

Korey E. Kahler
Stephen F. Austin State University, kkahler@sfasu.edu

Testing the Effectiveness of Lecture Capture Technology Using Prior GPA as a Performance Indicator

Michael D. Stroup, Michael M. Pickard, and Korey E. Kahler
Stephen F. Austin State University

Introduction

This empirical study examines whether making lecture capture technology available in a face-to-face lecture environment can improve students' ability to learn the course material. We examine student performance in undergraduate principles courses in computer science and economics. However, rather than simply comparing average course grades between lecture capture and non-lecture capture classes, we use student grade point average (GPA) as a predictor of course grades earned in non-lecture capture classes and lecture capture classes taught by the same professors using the same course materials. Our results imply that making lecture capture technology available in face-to-face lectures does not appear to impact high GPA students' ability to learn the course material one way or the other. However, low GPA students in one of the lecture capture courses earned significantly lower grades relative to low GPA students in the non-lecture capture class.

Previous Empirical Analysis of Lecture Capture Technology

Lecture capture is an umbrella term describing the technology that allows instructors to record their lectures and make them available to students in a digital format for later viewing and/or listening. The technology may be as simple as recording the audio and video components of a face-to-face lecture for later viewing, or it may be as sophisticated as integrating the video and audio tracks of the lecture with the projected presentation materials used by the instructor while delivering the lecture. Using lecture capture systems offers at least three potential benefits for students: 1) it is a back-up source for learning the material when students miss a class; 2) it is an opportunity for carefully reviewing the lecture content that was previously viewed in person; and 3) it is a source for creating audio/visual content for use in supplemental online materials for face-to-face lectures, or digital materials for online course development. It can enhance and extend existing instructional activities, whether in face-to-face, fully online, or in blended learning environments.

Many studies find that lecture capture technology has enhanced student performance in many undergraduate courses in the areas of engineering (Cramer et al., 2008), psychology (Day & Foley, 2006) and law (Whitley-Grassi & Baizer, 2010). However, Owston et al (2011) claim that whether access to captured lectures actually leads to improved student academic performance is still an open question. They cite many other studies comparing student performance in classes with and without lecture capture that show marginal, if any, improvement. For example, a three-year study conducted at multiple universities in multiple courses found no measurable impact on grades because of use of lecture capture (Brotherton & Abowd, 2004). Another study found no significant difference in student performance between two economics classes, despite 48% of students reporting the perception that their own performance was enhanced by use of lecture capture. Further, Euzent et al. (2011) observed higher withdrawal rates from the lecture capture sections, and Fernandes et al. (2008) found evidence of decreased student performance associated with diminished attendance of lecture classes attributable to the availability of lecture capture. A consensus opinion on the efficacy of lecture capture technology has yet to be formed.

Some studies find that students who are often absent from face-to-face lectures can be assisted by using lecture capture technology (Weiling & Hofman, 2010). Further, despite persistent concerns about the value of lecture capture as an educational tool, vendor surveys confirm that lecture capture is popular among students (Smithers, 2011; Secker et al., 2010). Other studies find that a strong majority of students claim lecture capture technology has allowed them to learn more material more efficiently (Carter, 2012). A literature review by Secker et al. (2010) reveals that few peer-reviewed publications support the notion of improved student performance and retention because of lecture capture, but it does note that more recent studies confirm high student enthusiasm for the technology. It appears that many of the studies performed to date that support lecture capture technology in face-to-face lectures have relied strongly on student surveys rather than the analysis of actual performance data.

Our methodology tries to control for the difference in a student's potential to learn the course materials across samples, as indicated by his or her GPA prior to taking the course. We use student GPA alone in a simple linear regression model to explain observed variation in student grade performance in both lecture capture and non-lecture capture courses. We then compare the intercept and slope estimates between these two regressions to see if the difference in their values are statistically significant. If lecture capture technology enhances learning, then students should be able to achieve a higher course grade in the lecture capture course than their GPA would indicate, based on student performance in the non-lecture

capture course. In other words, a student should be able to leverage his or her GPA into a higher course grade in the lecture capture courses.

Our analysis of student performance in an undergraduate computer science course indicates that there was no statistically significant difference in the performance of either high GPA or low GPA students in the lecture capture sections relative to the non-lecture capture sections of the same class. This result is obtained despite the course being delivered by the same professor using the same text and course materials. However, our analysis of an introductory economics course suggests that low GPA students in the lecture capture course sections were not able to achieve as high a course grade relative to low GPA students in the non-lecture capture course sections. Yet, the statistical significance of this difference disappeared among higher GPA students.

The Structure of the Data

Four sections of an Introduction to Computing (CSC 101) course were delivered in the traditional face-to-face lecture format in the fall semester of 2011 without lecture capture technology. Four sections of the same course were delivered by the same professor using the same course materials in the spring semester of 2012 with lecture capture technology. Similarly, two sections of a Principles of Microeconomics (ECO 232) course were delivered in the traditional face-to-face lecture format in the spring of 2011 without lecture capture technology. Two sections of the same course were delivered with lecture capture technology by the same professor using the same course materials in the spring of 2012. Every face-to-face lecture in every section with lecture capture technology was recorded with the ECHO 360 technology. All lectures were made available to the students within one or two days of the lecture being delivered, and all students were given 24 hour access to all recorded course materials throughout the entire semester.

The ECHO lecture capture system records each lecture in separate audio and visual feeds, and also records a direct video feed of the materials being displayed by computer projector during each lecture. All three independent feeds can be observed by the student simultaneously or separately, using a free and self-contained program. This program was made accessible in every student's personal university webpage. This means all students had 24 hour access to all lecture capture materials, which could be viewed on any device that could browse the Internet and play low resolution videos. Further, the instructors encouraged students to view the lectures. They informed the students in each section of both classes how to access the recorded lecture materials and physically demonstrated how to view the lectures and accompanying materials.

In all of these sections, each student's cumulative GPA prior to taking the course (as measured on a four point scale) was recorded and compared to their earned course grade (as measured as a percent of total possible course points). In this way, each student's prior GPA is used as an explanatory variable in a linear regression equation to explain the observed variation in the dependent variable of course grade earned. The data was collected in this manner to avoid any particular bias that might complicate a direct comparison of the average course grades between classes. If students with a higher GPA can be expected to earn a higher course grade in any given class, and if one class had a greater proportion of high GPA students relative to another, then a simple comparison of the average course grade across these courses might produce a misleading conclusion. Controlling for each student's prior GPA can provide a more accurate comparison.

The four sections of the fall 2011 computer science course without lecture technology were combined into a sample of 180 students, while the four spring 2012 computer science classes with lecture capture technology were combined into a sample of 306 students (this large difference in sample size is explained below). The two sections of the spring 2011 principles of microeconomics course without lecture capture were combined into a sample of 68 students, while the two sections of the spring 2012 course with lecture capture were combined into another sample of 100 students. In each case, the same instructor taught all of the sections of their respective discipline, and both instructors gave the standard number of face-to-face lectures in each section. The only relevant difference was that those students enrolled in the lecture capture sections of the 2012 course could access digital audio/video recordings of each lecture along with the accompanying computer images and Power Point slide presentations.

There were two types of students not included in these sample numbers: 1) the students who officially withdrew from class or stopped turning in any graded material after the first few weeks of school, and 2) the incoming freshman students who had no prior GPA to report before taking the class. While enrollment attrition in lecture capture courses is a debated topic, our goal in this analysis is to measure the performance of those students who remained engaged for the majority of the course.

In the case of the computer science courses, these exclusions amounted to 60% of the students in the fall of 2011 course sections, and 12% of the students in the spring of 2012 course sections. The large reduction in the fall 2011 sections resulted mainly from its being a popular class for first semester freshman students who do not have a college GPA to report. Conversely, the majority of the spring 2012 students had taken at least one

semester of college classes, meaning that this sample was a larger portion of the total course enrollment. A vast majority of the students enrolled in the economics course sections were sophomores or juniors with a prior college GPA to report. As a result, the proportion of exclusions in these sections was much smaller, amounting to less than 10% of the students in either the 2011 or 2012 sample.

Before analyzing the statistical results, it is important to try to estimate the extent to which the students in all sections of the lecture capture courses actually utilized the lecture capture materials made available to them. With respect to the computer science course sections, a short survey was given to all the students in all four lecture capture sections. (Unfortunately, this same survey was not given to the economics lectures.) The survey asked two questions:

1) *Please indicate the number of times you used the recordings per week.* The percent of students in each of the four sections replying that they used the materials one or more times per week ranged from 91% to 96%.
2) *Do you feel that your performance in CSC 101 was better due to the recordings being available (yes/no)*? The percent of students in each of the four sections replying in the affirmative ranged from 88% to 98%.

Also, the total number of lecture viewings for each course section in both the computer science and the economics courses were recorded by the ECHO software. If the number of viewings in each section is divided by the number of students enrolled in each section, one can calculate an average number of viewings per student in each section. Clearly, some students viewed the lecture material multiple times while others may not have viewed the materials at all, but it is still worthwhile interpreting such an average rate of student viewing of lecture materials. This is akin to calculating the average income of a U.S. citizen by dividing the total income earned by everyone living in the U.S. by the total number of people living in the U.S., knowing that some individuals, such as the very young and very old, did not directly earn any income at all.

The average number of viewings in each of the four computer science course sections ranged from 17.1 to 23.5 per student over the course of the semester. The average number of viewings in each of the two economics course sections ranged from 8.1 to 9.7 viewings per student over the course of the semester. In all, it appears reasonable to conclude that many students in each section of both courses had utilized the lecture capture technology to some extent in their studies.

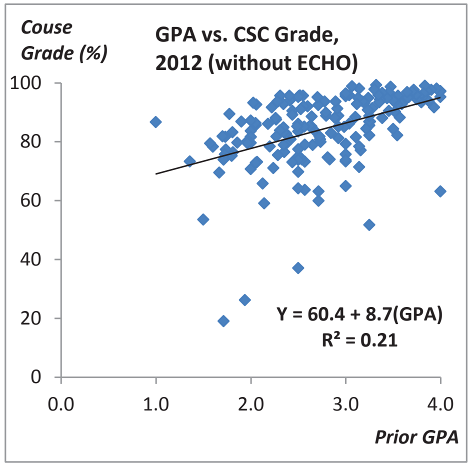

Figure 1

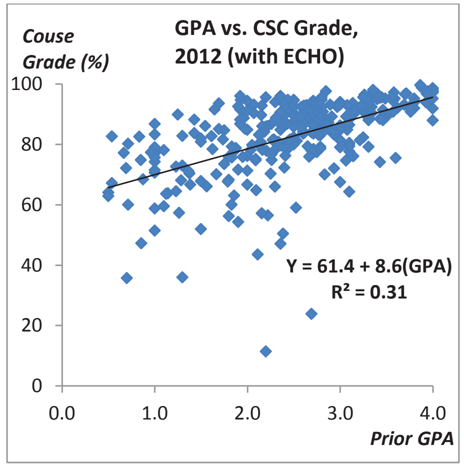

Figure 2

The Empirical Results

It is worthwhile to examine whether the two groups (non-lecture capture and lecture capture classes) created significantly different average course grades. The average course grade in the computer science course in the four non-lecture capture sections taught in the spring semester of 2012 was 84.31%. The average course grade in the four lecture capture sections taught in the fall semester of 2012 was 82.75%. A one way analysis of variance (ANOVA) test yields an F-ratio statistic of only 3.47, indicating the difference in these two sample means are not statistically significant at the 5% level of confidence. Indeed, these results mirror another empirical study of the performance and attitudes of computer science students who had access to lecture capture technology (Settle and Davidson, 2011). This study found that most of the students surveyed found the technology useful and they believed that it improved their course performance. However, the study did not find a statistically significant difference in student performance due to lecture capture.

On the other hand, would comparing average course grades between these two groups of classes be sufficient to draw trustworthy conclusions? If a student's prior GPA is a good indicator of his or her future course grade, then we would expect a class with a higher average GPA to create a higher average course grade. It is entirely possible that lecture capture technology enhanced the learning experience of a class of students with a relatively lower average GPA, enabling these students to achieve a higher average course grade equivalent to that earned by the higher average GPA class.

We can control for this possibility by linking each student's prior GPA with their earned course grade to examine whether students with access to lecture capture technology are able to leverage their GPA into a higher course grade. If lecture capture technology assists students in learning course material, then we should observe that the ability of students to convert their GPA into a higher course grade is, on average, greater in lecture capture courses than in non-lecture capture courses.

Figure 1 illustrates the positive relationship between a student's prior GPA and earned course grade in the 2011 computer science course delivered without lecture capture technology. It also shows the estimated regression line depicting the slope of that relationship. Figure 2 illustrates a positive relationship and regression line for the 2012 course delivered with lecture capture. In both cases, a simple linear regression was estimated using only an intercept and prior GPA as an explanatory variable. The value of the intercept can be interpreted as the grade (in percent) that a student could expect to earn given a prior GPA of 0.0. The slope estimate can be interpreted as the resulting increase in earned course grade percentage that any student can expect from a full point increase in his or her prior cumulative GPA, such as the difference in a 2.0 GPA and a 3.0 GPA.

If lecture capture technology makes a difference in student learning, then we would expect to see a difference in the impact that prior GPA has on students' final course grade. The intercept and slope estimates for both samples are reported in Table 1. The intercept and slope estimates in each equation were all found to be statistically significant at the 1% confidence level, supporting the notion that student GPA is a good indicator of a student's future earned course grade.

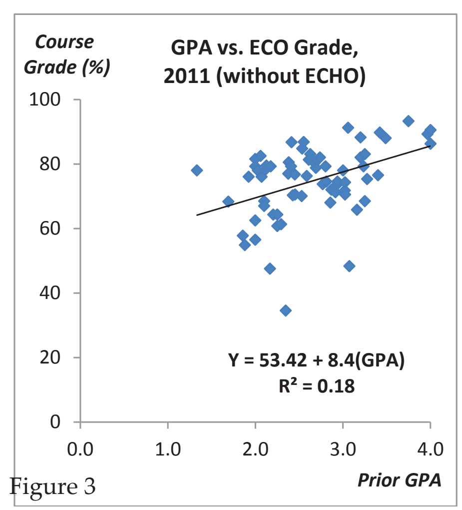

Figure 3

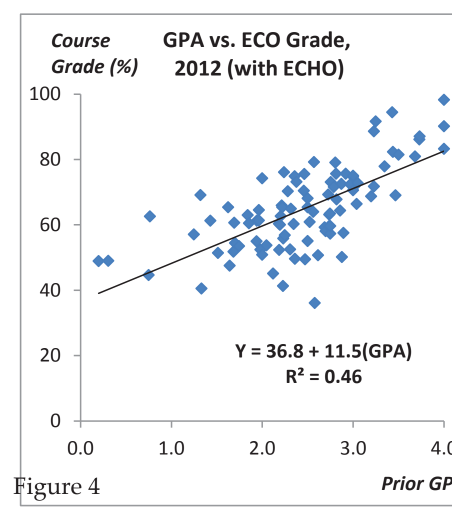

Figure 4

	Intercept	*Slope Coefficient*	*R-squared Value*	*Average Student GPA*	*Average Course Grade*
Fall 2011 (w/o lecture capture)	*60.43%*	*+ 8.66*	*0.20*	*2.76*	*84.3%*
Spring 2012 (with lecture capture)	*61.39%*	*+ 8.57*	*0.31*	*2.49*	*82.7%*

Table 1

Are the indicated intercept and slope coefficients across lecture and non-lecture classes statistically different from each other? The intercept and slope estimates for both samples appear to be very similar. This implies that there is little difference in predicted student performance across the two samples. A simple Chow test using an F-distribution can compare the total sum of squared errors of these two separate regression estimates with the sum of squared errors for a single regression estimated from the combined samples. This test finds that the variable estimates from the two separate regression equations are not statistically different from the estimates from the combined sample, even at a low 10% confidence level. This implies that lecture capture technology has had no effect, either positive or negative, in the level of student learning in our principles of computer science courses.

We now turn to the data from the introductory economics course sections. The average course grade earned by students in the two non-lecture capture sections taught in the fall semester of 2011 was 74.68%. The average course grade earned by students in the two lecture capture sections taught in the fall semester of 2012 was 64.89%. An ANOVA test yields a large F-ratio statistic of 51.78, which reveals that the difference in these two sample means is statistically significant at the 5% level of confidence.

Figures 3 and 4 illustrate the positive relationship between student GPA and earned course grade in the spring 2011 economics course sections delivered without lecture capture technology and 2012 sections delivered with lecture capture technology. The intercept and slope variable estimates are also reported in Table 2. All estimated variables were found to be statistically significant at the 1% confidence level for both equations. Again, the average grade in the course without lecture capture technology is lower, but so is the average student GPA for that sample.

The non-lecture capture class generated a slope value of 8.0 for predicting students' course grades based on their prior GPA. This means

a 3.0 GPA student in the non-lecture capture course can expect to earn an extra 8 percentage points on his or her final course grade relative to a 2.0 GPA student. However, the same 3.0 GPA student in the lecture capture course can expect to earn an extra 11.45 percentage points on his or her final course grade. At first, this appears to show how a student in the lecture capture class is able to leverage his or her GPA into a higher course grade. However, the intercept in the lecture capture course is much lower, meaning they have a deeper hole from which to climb out.

	Intercept	**Slope Coefficient**	**R-squared Value**	**Average Student GPA**	**Average Course Grade**
Spring 2011 (w/o lecture capture)	*53.42%*	*+ 8.04*	*0.18*	*2.64*	*74.68%*
Spring 2012 (with lecture capture)	*36.77%*	*+ 11.45*	*0.46*	*2.38*	*64.88%*

Table 2

Ultimately, a low GPA student is predicted to earn a much lower course grade when lecture capture technology is available. Even the highest grade predicted to be earned by a 4.0 student in the lecture capture sample is still slightly less than the highest predicted grade in the non-lecture capture sample. This implies that while high GPA students may not be affected by the presence of lecture capture technology, low GPA student performance appears to be diminished by lecture capture technology.

This time a simple Chow test finds that the variable estimates from the two separate regression equations are indeed statistically different from the combined sample at a 1% confidence level. Further, the difference between predicted grades for higher GPA students in the two samples is not statistically significant while the difference in predicted grades for low GPA students is significant. Using the standard error of the regression to create a 95% confidence interval about the regression line, the difference in predicted grades between samples becomes statistically insignificant for any GPA value higher than 2.10. It appears that above average GPA students are not affected.

Conclusion

The above statistical analysis suggests that making lecture capture technology available in face-to-face lecture courses in introductory computer science does not have a statistically significant impact on student performance, as measured by course grade. Even after controlling for the possible influence of a student's GPA on his or her earned course grade, no statistically significant difference in earned course grades between the lecture capture and non-lecture capture courses were found. However, making the same technology available to introductory economics students in face-to-face lecture courses does appear to produce a statistically significant impact on student performance. Specifically, lower GPA students (below 2.1 GPA) in the lecture capture course did not achieve as high a grade as their low GPA counterparts in courses without lecture capture technology. High GPA student performance, however, appears to be unaffected by the presence of lecture capture technology.

These empirical results are puzzling, given that the technology was an optional and readily available tool in a face-to-face course that was not required for student learning and did not directly impact a student's course grade. There are many possible explanations, but one seems worthy of pursuing more carefully with future empirical analysis. Assuming that most students have a similar intellectual capacity to learn, a higher student GPA might generally indicate a student with a higher degree of self-discipline and greater commitment to the process of learning. Likewise, a lower student GPA might indicate students with many distractions in life preventing them from achieving a high level of commitment to learning. This could be the result of financial stresses forcing them to work part-time during school, serious family strife distracting their attentions, or lack of the emotional maturity to recognize the value in delayed gratification that is necessary to be successful in the learning process.

If true, then this reality could produce the unexpected empirical results that we have observed in the economics course. Whereas high GPA students would more likely attend class regularly and complete assignments faithfully, low GPA students would more likely miss some lectures and fail to complete some class assignments. If lecture capture technology was seen by all students as an effective avenue for making up missed lectures, its efficacy in promoting student learning would depend on how well students actually utilized it. If lower GPA students were lured into thinking that they would make up their many missed lectures by viewing them later online, but they generally failed to follow through and actually view the captured lectures, then one would expect many of the lower GPA students to have succumbed to a false sense of security in relying on lecture capture technology to save them from their lack of a personal commitment to learning. In other words, it is possible that lecture capture technology could be an enabler for less committed, low GPA students to shirk their responsibilities and fail to engage in those activities that promote effective learning.

However, it would be necessary to tie student GPA with lecture capture viewing rates to explore this possibility further with future empirical research. While the ECHO lecture capture software is not capable of recording and collating individual-specific data, perhaps a focused survey of students during the last week of class would reveal whether or not this tends to be the case. Asking students their GPA, the number of lectures they missed, and the number of lectures that they actually viewed using the lecture capture technology may reveal whether there is a trend of low GPA students missing more face-to-face lectures and viewing fewer lecture capture lectures than high GPA students. In this way, the relationship between an individual student's performance and his or her lecture capture viewing habits could be directly measured.

This is our suggestion for further empirical analysis. It would be important to determine whether lecture capture technology inadvertently tends to enable unproductive learning behavior by relatively low GPA students. If so, then using lecture capture technology in face-to-face lectures, if not employed properly to account for this reality, would culminate in less aggregate student learning of course material, as indicated by poorer average grades in each course.

References

Brotherton, J. & Abowd, G. (2004). Lessons learned from eClass: Assessing automated capture and access in the classroom. *ACM Transactions on Computer-Human Interaction (TOCHI), 11*(2), 121-155.

Carter, D. (2012, June 1). Lecture capture remains popular despite controversy, lack of funding. *eCampusNews*, 1-2. Retrieved from http://www.ecampusnews.com

Corliss, S., Heikes, J. & Heidenreich, M. (2010). *Echo360 Pilot: Fall 2009 Results*. Evaluation Report by the University of Texas at Austin.

Cramer, K. M., Collins, K. R., Snider, D., & Fawcett, G. (2007). The virtual lecture hall: Utilisation, effectiveness and student perceptions. *British Journal of Educational Technology*, *38*, 106–115.

Day, J., & Foley, J. (2006). *Evaluating web lectures: A case study from HCI*. Paper presented at the Conference on Human Factors in Computing Systems, Montreal, Quebec, Canada.

Educause. (2008, December 19). *7 things you should know about lecture capture*. Retrieved August 8, 2012, from http://www.educause.edu

Euzent, P., Martin, T., Moskal, P., & Moskal, P. (2011). Teaching principles to the masses: Assessing student performance in lecture capture vs. face-to-face course delivery. *Social Science Research Network*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1868945.

Fernandes, L., Maley. M., & Cruickshank, C. (2008). The impact of online lecture recordings on learning outcomes in pharmacology. *Journal of the International Association of Medical Science Educators*, *18*(2), 62-70

Owston, R., Lupshenyuk, D., & Wideman, H. (2011). Lecture capture in undergraduate classes: Student Perceptions and Academic Performance. Internet and Higher Education

Secker, J., Bond, S., & Grussendorf, S. (2010). Lecture capture: rich and strange, or a dark art? Paper presented at ALT-C 2010 conference at the University of Nottingham, Nottingham, UK.

Settle, A., Dettori, L., & Davidson, M. (2011). Does lecture capture make a difference to students in traditional classrooms. *Proceedings of the 16th annual Joint Conference on Innovation and Technology in Computer Science Education*, New York, NY, USA, 78-82. doi:10.1145/1999747.1999772

Smithers, M. (2011, March 11). Is lecture capture the worst educational technology? [Web log message]. Retrieved from http://www.masmithers.com/2011/03/11/is-lecture-capture-the-worst-educational-technology/

Whitley-Grassi, N., & Baizer, J.S. (2010). Video lecture capture in physiology courses: Student attendance, video viewing, and correlations to course performance. *International Journal of Instructional Technology and Distance Learning*, 7(10). Retrieved from http://www.itdl.org

Wieling, M., & Hofman, W. (2010). The impact of online video lecture recordings and automated feedback on student performance. *Computers & Education, 54*(4), 992-998. Retrieved from http://dx.doi.org/10.1016/j.compedu.2009.10.002