Lecture Capture: Student Performance and Perceptions

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Technology is a given in the contemporary classroom; however, its effectiveness demands our scrutiny. Recent advancements in lecture capture (LC) software allow more instructors to implement this technology in the classroom. To determine effectiveness, grade means as well as mean percentage of A and B grades from courses with and without LC available were analyzed. As a complement, student surveys also gauged perception of LC. The use of advanced teaching technologies is not guaranteed to improve student success; however, this research indicates implementation of LC promotes the learning cycle and provides students the opportunity to improve their performance.

A successful teacher develops a practical teaching philosophy that considers how people learn. It is best if that philosophy is shared with, understood by, and easily practiced by students themselves. We know from many studies that students learn best when given the opportunity to experience new ideas or concepts and then reflect on new material so that information can be added to their base of knowledge; that is to construct their own knowledge. Moreover, as teachers, we hope that students begin to extend that knowledge by developing their own new ideas and then testing those ideas. This allows students to develop the critical thinking skills that will best prepare them for future careers not likely to even exist today (Fisch & McLeod, 2015).

More recently, the explosion of new teaching technology and the implementation of technology by educators have made the classroom experience more dynamic than ever. Far beyond the chalkboard and PowerPoint, teachers now have a vast array of content delivery modes and modules including varied presentation tools, social networks, discussion boards, web-tools and web-resources which should allow for a more active learning environment. However, all too often classroom instruction remains a one-way flow of information from instructor to student, and students do not get the opportunity for reflection, much less, a chance to think critically,

to develop new ideas, to test if those ideas are correct, and finally to begin again learning new information, building on prior knowledge.

Educational institutions are investing in technologies that allow for a more dynamic learning experience, especially web-based learning technologies (Hollands & Tirthali, 2014). One technology known as lecture capture (LC) allows students to review audio and/or visual recordings of face-to-face lectures as media files 'streamed' *via* the internet or downloaded as 'podcasts.' LC has not only changed the means in which information is conveyed to students (Woo et al., 2008) but also fundamentally altered the ways by which students learn (Gorissen et al., 2012; Gosper et al., 2008; Soong et al., 2006; Traphagan et al., 2010).

Students enrolled in courses that have LC available are provided a unique and often overlooked learning opportunity: time for reflection. An essential aspect of the learning cycle -reflection and time for reflection- is critical to building knowledge (Zull, 2002). Students using LC have more control over the material they study. The ability to pause and rewind recorded lectures allows a student more time to reflect on content presented. Providing students more time to relate new information to prior knowledge, another critical step of the leaning cycle (Zull, 2002), LC allows students to further develop their understanding of topics presented in class. Of course, others have reviewed potential benefits (Davis et al., 2009; Larkin, 2010; Preston et al., 2010) and possible deficits (Bennett & Maniar, 2007) of LC; however, very little is known of the specific impact LC has on biology student performance. In this study, I explore the effectiveness of LC in undergraduate biology classes at both the lower- and upper-levels as well as student perception of LC technology.

Experimental Design

To investigate the influence of LC on student classroom performance, four different introductory biology courses were taught both with and without LC available to students (for a description of each course, please see Appendix A). A student in their first or second year of college would typically enroll in these courses as part of the required course work for a major in biology. Course offerings without LC were held over a two-year period, offerings with LC available were also held over a two-year period.

It was a goal of this study to keep all aspects of each respective course identical, making the only course presentation variable the presence

or absence of LC. However, it must be noted that there are uncontrolled variables when making course comparisons of student performance. There exists an inherit difficulty when analyzing student performance by comparing different groups of students in the same course. For example, student drive and motivation, the level of background knowledge a student possesses, the type of questions and discussions that arise in class, and the extent to which students interact outside of class all of which could and likely will impact overall student performance. However, even in the presence of these uncontrolled variables, the nature of these variables are in and of themselves variable enough across the compared courses to negate any significant probable effect. The chance of any one class being composed entirely of highly gifted students is as likely as the chance of any one being composed entirely of students far less gifted students.

Panopto Focus is LC software that records lecture audio as well as presented imagery. Saved files are stored online *via* a course management system similar to Blackboard. A student can then access lectures by downloading the stored file or podcast, thus making lecture material avaiable for study and review anytime, anywhere. Students have unlimited access to all lectures so that they can review material daily and/or prepare for future lectures and exams. Playback of recorded files includes any visual imagery displayed on the instructor's computer screen as well as the captured audio of the instructor's voice. This particular LC software, also keeps record of individual student access details, specifically, the time and date a student accesses a particular recording and the duration of access.

To determine if this LC technology improves student performance, 451 student grades in four different courses over a period of four years were recorded and averaged by course to provide an overall course mean grade (see Table 1). Mean grade comparisons were analysed among courses with and witout LC available and graphed (see Figure 1) Additionally, the mean percentage of "A" and "B" grades earned by students was calculated per course (Table 1). To guage student perception of LC, I used a survey tool (Appendix B). Students enrolled in courses with LC completed the required survey online and the results were summareized (Table 2).

Results / Discussion

Mean course grade comparisons (Figure 1) and mean percentage of A and B grades comparisons (Figure 2) both indicate improved student performance overall for each of the four courses examined. Although the

amount of improvement in mean grades and mean percentage of A and B grades per respective course varied, a positive trend of improved student performance was observed in both cases. Analysis by comparison of means t-test ($p < 0.05$) did not yield statistically significant results for either mean course grade or mean percentage of A and B grades comparisons; however, this could be due to the low sample size (n). Some courses were only taught two times under the indicated conditions (Table 1. n values). Although $p > 0.05$, this does not suggest LC has no effect on student performance. Statistically, the effect may be small or there may not be enough samples to reveal the true influence of LC on student performance.

Of course, it is advantageous to use large sample sizes ($n > 3$) which can reduce error and produce a more precise estimate of the true mean. Adding samples would likely increase statistical analysis accuracy, but this would require keeping all aspects of these courses, including content, unchanged for several years. Some courses lend themselves more so to this practice. For example, a course in which the content tends to be static. However, the scientific field is dynamic and new information is continually added, forever extending the breadth of described scientific knowledge. I am not inclined to keep content unchanged in my courses for an extended period of time, as I believe including the most current findings relevant to my field is vital to the nature of science instruction. Adding additional sections could increase sample size; however, that would mean additional instructors which would significantly increase content presentation variability and likely skew results further. One possibility is to add online sections to the course, increasing sample size although doing so may lead to variable class experiences, in-person *vs*. online, which may again skew results.

Three of the four courses assessed demonstrated an increase in the mean course grade when LC was present with an average increase of +3.75 percentage points (pp) overall. Course #3 had the highest increase in mean course grade (+9.00pp) and course #2 had the lowest with a decrease in mean course grade (-2.00pp). When analyzing the mean percentage of A and B grades, all four courses demonstrated an increase when LC was present with an average increase of +17.25pp overall. Course #3 had the highest increase in mean percentage of A and B grades (+28.00pp) and course #4 the least (+7.00pp). Overall, it appears that the presence of LC improved student performance as evidenced not only by the increase in

mean course grade, but also by the increase in the number of A and B grades per respective course.

Course #1 is considered to be a non-major's biology course, whereas courses #2, #3, and #4 are part of the biology major's program of study. This research indicates non-major and major-level courses show improved student performance when LC is present. Overall, LC improved mean grade values and increased the number of A and B grades in both non-major and major level courses.

As instructors, we should value the opinions and perceptions of our students. That is why I created the LC student survey (Table 2). I wanted both to find data to support the idea that LC improved student performance and I also wanted to know the students' view on LC as it related to their own experiences in and outside of the classroom. Analysis of survey results indicated that 88% of students who had LC available, "agreed" or "strongly agreed" that LC significantly improved their ability to retain lecture material. Furthermore, 64% of students surveyed indicated they felt LC significantly improved their ability to understand material from lecture. Retention of material is foundational to the learning process, but understanding material is superior and allows a student to take the next step which is the application of knowledge (Bloom & Krathwohl, 1956) to new and different content related questions and scenarios. Whether LC significantly impacted a student's understanding of course materials or not, it is clear that most students surveyed (99%) found LC helpful and preferred having LC available than not available, data that supports previous findings (Copley, 2007; Pilarski et al., 2008; Salmon & Edirisingha, 2008; Woo et al., 2008). Survey results also demonstrated that 93% of students reported this to be their first class with unlimited access to recorded lectures, a trend that may be changing as automating LC becomes more reliable and the positive influence LC has on student performance becomes more clear (Stroup et al., 2012; Wieling & Hofman 2010).

Although it seems evident from this research that LC aids student performance (Figures 1 and 2), the scope of its effectiveness remains to be determined. A more accurate depiction of how much LC helps to improve student success could be gained by analyzing how much time students spend utilizing LC and how their grades are affected.

One of my goals is to encourage active learning in and outside of the classroom so that more students get to the process of reflection and then to the development of new ideas -critical steps of the learning cycle. These

skills are vital to student success and important in all fields of endeavor; however, we cannot necessarily expect students to learn these skills on their own. LC provides the student an intended alternative experiential learning oppourtunity, and the trends demonstrated in Figures 1 and 2 reveal students benefit from the presence of LC by way of mean course grade and mean percentage of A and B grade comparisons for all of the courses observed. No matter the means, the fundamental goal of educators is student success and achievement. Ultimately, success is demonstrated by the student's ability to apply the concepts and knowledge, learned in class, to new problems. Some reflection on both the content and the method of instruction can help us to achieve this goal.

Table 1. Student Performance Data. Courses (#1-#4) were taught both without (-) and with (+) lecture capture available to students "*n*" times. Individual course means were averaged to produce the overall mean course grade for comparison; additionally, the overall mean percentage of "A" and "B" grades per course was calculated as an indicator of student performance.

Course	#1		#2		#3		#4	
Lecture capture	-	+	-	+	-	+	-	+
n	4	4	3	2	2	2	3	2
Individual course means	68	86	83	85	74	84	81	83
	81	72	81	80	78	85	77	82
	73	75	83				82	
	67	76						
Total number of students	129	77	52	37	26	37	54	39
Overall mean course grade	72	77	82	80	76	85	80	83
Standard deviation	5.540	5.262	0.943	2.500	2.000	0.500	2.160	0.500
Overall mean percentage of A & B grades	38%	52%	57%	77%	45%	73%	58%	65%

Figure 1. Student Performance Means Without & With Lecture Capture (LC). Over a four-year period, 451 student grades from four different introductory biology classes (#1-#4) taught both without and with LC are shown. Error bars indicate standard deviation calculated from student performance data (Table 1).

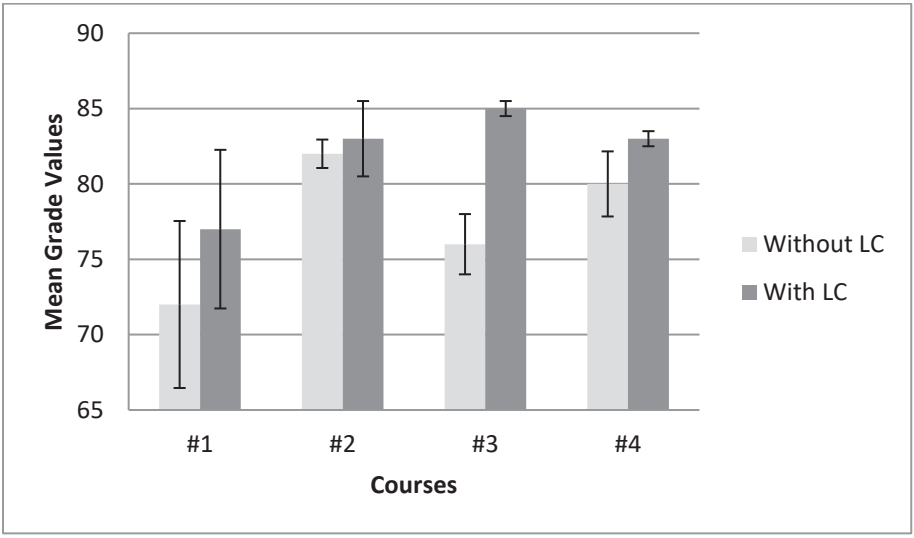
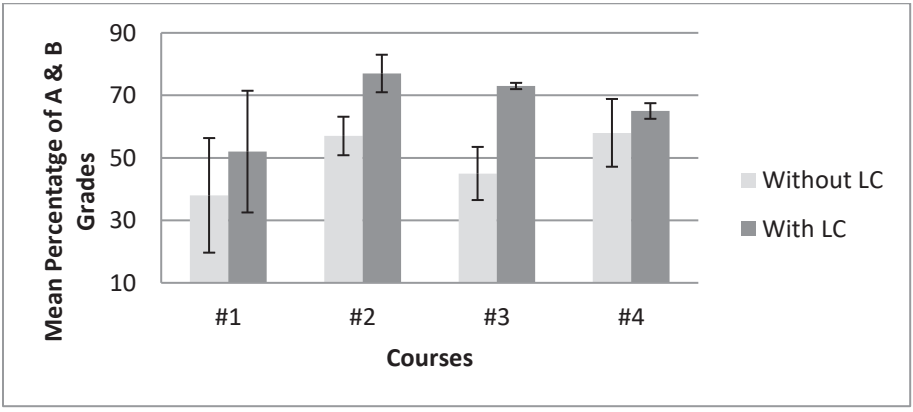


Table 2. Lecture Capture Student Survey. Student perception of LC was surveyed by five questions. Results, by percentage, are shown next to each respective rating. Total number of students surveyed 190.

Survey Question	Percent Respondents	Rating
Lecture capture (Panopto Focus) significantly improved my ability to retain lecture material.	23%	Strongly Agree
	65%	Agree
	10%	Neutral
	2%	Disagree
	0%	Strongly Disagree
Lecture capture (Panopto Focus) significantly improved my ability to understand lecture material.	18%	Strongly Agree
	46%	Agree
	21%	Neutral
	15%	Disagree
	0%	Strongly Disagree
I found lecture capture (Panopto Focus) to be overall helpful to me during this course.	21%	Strongly Agree
	78%	Agree
	< 1%	Neutral
	<1%	Disagree
	0%	Strongly Disagree

I prefer having lecture capture (Panopto Focus) recordings available to me rather than not available during this course.	93%	Strongly Agree
	6%	Agree
	< 1%	Neutral
	0%	Disagree
	0%	Strongly Disagree
How many face-to-face lecture courses have you taken that have allowed students unlimited access to recorded lectures?	93%	This was my first
	6%	2-3
	< 1 %	4-6
	0%	>6

Figure 2. Mean Percentage of A & B Grades Without & With Lecture Capture (LC). As an indicator of overall student performance, the mean percentage of A & B grades from the four different courses (#1-#4) taught both without and with LC are shown. Error bars indicate standard deviation calculated from student performance data (Table 1).



Appendix A

Course Descriptions

Course #1 (*Anatomy and Physiology I*)

This course covers the structure and functionality of the human body; more specifically, the skeletal, muscular, nervous and sense systems. These body systems are studied at the cellular, tissue, organ, organ system

and whole-body levels. This is a non-majors course designed for students entering into the allied health care profession and does not require a pre- or co-requisite. This course was taught four times without and with LC available to students.

Course #2 *(Principles of Biology I*)

This class is one of the first in a series that can lead a student to a biology major. This course explores the fundamental mechanisms and processes that occur at the molecular, cellular, organismal, and ecological levels of biology. This course begins with basic scientific principles that will form a base knowledge so students can further explore biological diversity. Completion with a passing grade is required to take all upper-level biology courses. This course requires a chemistry course as a pre- or co-requisite. This course was taught three times without LC available to students and two times with LC available to students.

Course #3 *(Principles of Biology II*)

This course is the second part of the introductory series for biology majors and will guide students through the diversity of animals, nutrients and energy, transport, homeostasis, animal behavior, and ecology. Completion with a passing grade is required to take all upper-level biology courses. This course also requires a chemistry course as a pre- or co-requisite. This course was taught two times without LC available to students and two times with LC available to students.

Course #4 (*General Genetics*)

Student must complete and pass the introductory Principles of Biology series (Courses #1 & #2) to register for this 200-level class. This course examines the concepts of genetic inheritance, gene/genome structure, regulation of expression, genetic engineering, implications of mutation and the molecular genetics of cell cycle regulation and cancer. Students must receive a “C” or better in this course to progress further in the biology major. This course was taught three times without LC available to students and two times with LC available to students.

Appendix B

Student Survey

1. How would you rate the following statement:

"Panopto significantly improved my ability to retain lecture material."

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

2. How would you rate the following statement:

"Panopto significantly improved my ability to understand lecture material."

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

3. How would you rate the following statement:

"I found Panopto to be overall helpful to me during this course."

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

4. How would you rate the following statement:

"I prefer having Panopto recordings available to me rather than not available during this course."

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

5. How many courses have you taken that have allowed students unlimited access to recorded lectures?
    A. This was my first
    B. 2-3
    C. 4-6
    D. >6

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Author Note

1. This research was conducted under the approval of the Institutional Review Board (IRB).

Personal Biography

I began teaching at the University of Akron Wayne College in 2010 at which time my research interests shifted from developing embryos (reproductive physiology) to developing minds (cognitive physiology). My teaching focus has centered on incorporating active learning and metacognitive strategies in both online and traditional on-ground courses.