Using Lecture Capture to Improve Online and In-Class Student Performance in Principles of Economics

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Abstract

The primary purpose of deploying a lecture capture method of course delivery is to enhance student performance in online classes. In this study, recordings of classroom lectures are available to students in online sections of the course, as well as those taking the class in face-to-face class sections. We examine the effects of viewing these recorded lectures on student performance in principles of economics courses (macro and micro) over the course of five years. The setting is a small regional university that serves an extensive rural area. The dataset consists of close to 700 students, 55% of which enrolled in online course sections. Course grades, as the dependent variable, are regressed on measures of personal characteristics and academic maturity, as well as use of the recorded lectures. Results indicate that online students who watch the recorded lectures earn course grades that are significantly higher than counterparts who do not. There is also evidence that students in the face-to-face course sections also benefit significantly from watching recorded lectures.

Eastern New Mexico University (ENMU) is a four-year, comprehensive, regional school that serves an extensive and sparsely populated area. The College of Business (COB) has long been proactive in the development of enhanced opportunities for distance students to be able to complete degrees at ENMU. Lecture capture, through Mediasite,[1] is the most recent course delivery technology used on this campus to support distance education.

This study assesses the use of lecture capture in twocourses, Principles of Macroeconomics (macro) and Principles of Microeconomics (micro), offered during fall and spring semesters from August 2011 through May 2016. A unique feature in the COB is that course delivery is "blended" or "cross-listed" as separate sections of online-only students and face-to-face students all access the same course materials and complete the same requirements.

An early study by Flores and Savage (2007) reported on student use of "real-time lectures recorded on video and streamed over the internet," (p. 57), within a single face-to-face classroom. Students could access the recorded lectures at any time during the semester. The technology at that time constrained the instructor to the podium during class and the authors used "choice experience data to estimate economics students' willingness to pay for streaming video and instructor movement away from the podium." Within this choice experiment framework, the authors did find a positive correlation between student performance in the course, measured by the course grade, and watching the videos.

[1] Mediasite is a lecture capture system offered by Sonicfoundry (www.sonicfoundry.com).

Studies that are more recent have focused on isolating the effects of lecture capture by making it available only to students enrolled in online sections of the course and restricting access to face-to-face students.

Euzent, et al, (2011) "examined student performance, student satisfaction and student evaluation of instruction in two large (N>300) introductory Economics course sections" where one section was offered in the classroom and the other through lecture capture only. "The instructional methods, assignments, exams, and instructor were the same for each section over two consecutive semesters," and the first author taught all four sections of the course (p. 295). The authors did not record lectures in the face-to-face sections. Instead, the lecture capture "courses were taught in a 280-seat multi-media classroom. ..." and online "students were given the option to attend the live origination section on a first-come, first-served basis, but only about10% of students regularly attended" (p. 299). The authors found, "no significant differences in student performance across the two delivery formats, though there was a higher withdrawal rate in the LC [lecture capture] sections (5.1% TO 1.9%). Student survey results reported, "Eighty percent indicated that the LC course was as good as or better than a traditional large lecture course taught face-to-face, and 73% reported that they would choose to take another LC course" (p. 295).

Figlio, Rush and Yin (2013) were able to test the effects of online vs. in-class instruction on student learning within an experimental framework. "Students were randomly assigned to either an online or a live section of a course taught by one instructor and for which the ancillaries for the class, such as the web page, problem sets, and TA support, as well as the exams, were identical between the sections. The only difference between these sections is the method of delivery of the lectures: some students viewed the lectures live, as would be the case in traditional classes, while other students viewed the lectures on the Internet" (pp. 7765-766). In fact, the authors describe extensive measures taken to prevent students who registered in the live section from accessing the recorded lectures through their LMS accounts (p. 767). The study found, "modest evidence that live-only instruction dominates Internet instruction. These results are particularly strong for Hispanic students, male students, and lower-achieving students" (p. 763).

In their 2016 article, Bosshardt and Chiang focus on "the selection process and educational outcome differences between students enrolled in a lecture capture and traditional face-to-face course in economic principles...." and find "that students' attitudes toward online learning are the chief determinant of their choice of class over student demographics, opportunity cost measures, or past online experiences. Additionally, our findings suggest that lecture capture students perform as well as those who take a face-to-face course when not accounting for self-selection. When selection is taken into account, lecture capture is not significantly worse than face-to-face" (p.1021). These authors also offered students enrolled in the online section, "the opportunity to attend the taping of the class" though very few elected to do so. In addition, "Students enrolled in the face-to-face section were not given access to any recorded lectures from the other section, with no exceptions per college policy which charges students in the lecture capture section a $180 technology fee" (p. 1030).

In the courses studied here, instructors use PowerPoint slides to supplement their lectures.Mediasite records the slides and any other materials demonstrated to the class on a computer screen, including drawings and notes written on the slides by the instructor during class. Students who are not in the

classroom may login to the course shell through Blackboard (the electronic Learning Management System or LMS) and watch the course live, with a few seconds delay through video steaming. After the class is over, all students in the class can assess the Mediasite recordings of the lecturesat any time during the rest of the semester.

When students watch the Mediasite recordings, they see two screens, one showing the professor and the other the lecture slides or other course materials. There are several options for viewing the lectures that include pausing the recording, reviewing only specified parts of the lecture and enlarging or downsizing each of the screens independently. Students seldom report technical problems accessing the recordings and ENMU offers extended hours for assistance through a dial-in ITS Helpdesk.

Through lecture capture, class attendance can be required and there are no longer any excuses for missing class. Either students attend the lecture in person, or they watch the lecture online at their convenience. The Mediasite system provides instructors withreports detailing which students watched which lectures, how many times and for how many minutes.

This project also investigates differences in student performance as a function of online or in-class enrollment. On this campus, it would not be possible to randomize student enrollment by face-to-face or online section since the majority of students enrolled in online sections are distance students who cannot attend classes on campus. Some students on campus do select to enroll in the online section, usually due to scheduling conflicts with other courses or with work schedules. By blending the online and face-to-face sections as well as combining the two sections within one Blackboard shell, all students in the course have unrestricted access throughout the semester to recordings of the class lectures.

The primary research question for this study asks if student performance in principles of economics courses improves through viewing Mediasite recordings of the lectures, regardless of enrollment in face-to-face or online sections. The dataset includes all students enrolled Principles of Macroeconomics(macro) and Principles of Microeconomics (micro) during the fall and spring semesters of five academic years, 2011 to 2015. Table 1 gives the distribution of these students between macro and micro in face-to-face and online sections. Enrollments are larger in macro because this is a requirement for business majors as well as a popular course that fulfills a social science general elective requirement for all ENMU degrees. The micro sections tend to attract business majors only.

Table 1 –Students Enrolled in ENMU Principles of Economics Courses Fall 2011 through Spring 2016

Section	**Macro**	**Micro**	**Percentages**
Face-to-Face	208	105	*45%*
Online	234	149	*55%*
Percentages	*65%*	*35%*	*100%*

The dataset includes variables measuring student performance in the courses, academic maturity and individual characteristics and listed in Table 2.

Table 2—Variables Included in the Dataset	
Variable Name	***Description***
Course Grade	Letter grades assigned are A through F; A = 4, B = 3, C = 2, D = 1, F = 0. Grade distribution for the dataset is A = 30%, B = 32%, C = 20%, D = 68% and F = 8%
Year	Academic years 2011 through 2015; 2011 = 1, 2012 = 2, 2013 = 3, 2014 = 4, 2015 =5
Course	Macroeconomics = 0, Microeconomics = 1
Face-to-Face or Online	Face-to-face = 0, Online =1
ACT	Total ACT score; students who had SAT scores only were assigned the ACT equivalent using the College Board 2015 SAT-ACT Concordance Table; students with no ACT scores were assigned the mean score of 21
Imputed ACT	0 if ACT score imputed, 1 otherwise; 38% of ACT scores are imputed
Previous GPA	Cumulative grade point average in previous semester; students with no previous GPA assigned a zero
Imputed GPA	0 if previous GDP imputed, 1 otherwise; 12% of previous GPAs are imputed
Previous Hours Earned	Total number of credit hours earned at the end of the previous semester
Current Hours	Total credit hours taken during the semester observed
Gender	0 = male; 1 = female; 50.3% male and 49.7% female
Race dummy variables	Non-Hispanic White (White) = 1, Hispanic = 2, Non-Hispanic African American (Black) = 3, Asian/Pacific Islander (Asian) = 4, Native American/Alaskan Native (Native) = 5, Non-Resident Aliens (International) = 6
Mediasite	Percent of the number of available lectures viewed multiplied by the average percent of the total minutes watched for each lecture

We note that ENMU is a Hispanic-Serving institution and the distribution of students by race shown in Figure 1 is representative of the general population in New Mexico.

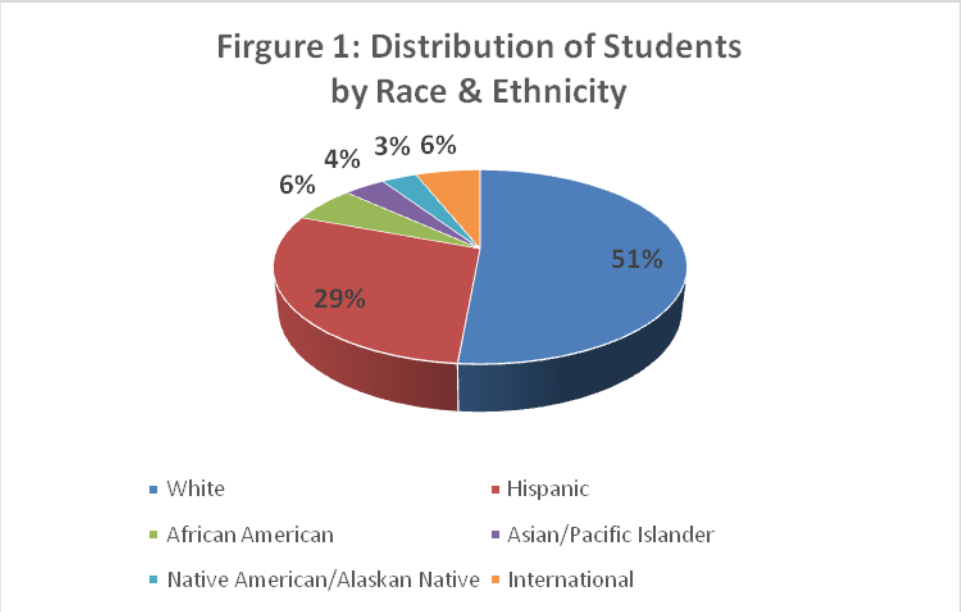

Table 3 gives selected descriptive statistics for the quantitative variables included in the dataset.

Table 3—Selected Descriptive Statistics for Quantitative Variables

	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
Course Grade	2.65	3.00	1.23	0	4
ACT scores	20.8	21.0	2.8	12	31
Previous GPA	2.75	3.05	1.11	0	4
Previous Hours Earned	66	64	44	0	218
Current Hours	13	15	4	3	24
Mediasite	26.4%	14.0%	28.9%	0	100%

Three OLS regressions test the effects of utilization of Mediasite recordings on student performance. In each of these, the course grade is the dependent variable. The other variables described in Table 2 are independent variables regressed on the course grade. In the first regression, all students in the dataset were included. The second regression focused only on students enrolled in the online course sections, while the third looked only at students enrolled in the face-to-face sections. Tables 4, 5 and 6 present the regression result. Highlighted in each table are the coefficient estimates that are statistically significant at the .05 level.

Table 4-- Regression Results of Course Grade for All Students

Multiple R	0.6013
R Square	0.3616
Adjusted R Square	0.3465
Standard Error	0.9971
Observations	696

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	1.899775381	0.395082768	4.808550351	1.87359E-06
Year	-0.045624642	0.028274379	-1.613639046	0.107070352
Course	-0.031363392	0.079863201	-0.392713941	0.694654025
Face-to-Face or Online	-0.537397744	0.094387837	-5.693506279	1.85301E-08
ACT	0.039397839	0.014541672	2.709305894	0.00691246
Imputed ACT	-0.08115973	0.101221536	-0.801802984	0.422947443
Previous GPA	0.97296883	0.084741197	11.48165078	5.19406E-28
Imputed GPA	-3.290753354	0.302859393	-10.86561432	1.82071E-25
Previous Hours	0.003388895	0.001125749	3.010347083	0.002706261
Current Hours	0.014546227	0.011483205	1.2667393	0.205682865
Gender	-0.119267816	0.076839383	-1.552170412	0.121087405
Hispanic	-0.145144163	0.091108215	-1.593096337	0.111603959
Black	0.016486564	0.16675406	0.098867543	0.92127262
Asian	0.160451945	0.203829271	0.787187945	0.43144653
Native	-0.636904878	0.219034042	-2.907789456	0.00375872
International	0.574589854	0.187642829	3.062146618	0.00228437
Mediasite	1.355791248	0.149842734	9.04809468	1.51383E-18

The first regression results from Table 4 indicate that students in the face-to-face sections of the course do have a statistically significant advantage over students in online sections. Students who enroll in face-to-face sections of the macro and micro courses can expect to earn half grade higher than students in the online sections do. Watching the Mediasite lectures, however contributes even more substantially to student performance for all enrollments. The coefficient estimate indicates that studentscan expect to increase their course grade by almost one and a half points, out of four points possible.

At ENMU, the macro and micro classes have no prerequisites and the data indicate that there is no statistically significant difference in grades earned by students in either course. The coefficient estimate on ACT scores is relatively small, but positive. There is no difference however between students who had ACT scores and those who did not, since the imputed ACT variable is not statistically significant.

The other measures of academic maturity, the cumulative GPA from the previous semester and the total

credit hours earned are also statistically significant and positive. In this dataset, no students without a GPA the previous semester had earned any credit hours. We assume these students are all first-time freshmen. The fact that the coefficient estimate for the imputed GPA of zero is negative and relatively large indicates that these sophomore-level classes in principles of economics are too difficult for students who have not yet successfully completed university coursework.

Coefficient estimates on other variables measuring student characteristics indicate no statistically significant effects on course grades due to the number of hours taken during the current semester, gender and Hispanic, African-American and Asian students compared to White students. Native American students tend to earn more than half a grade lower than White students, while International students tend to earn more than half a grade higher.

Table 5-- Regression Results of Course Grade for Online Students

Multiple R	0.6057
R Square	0.3669
Adjusted R Square	0.3410
Standard Error	1.0436
Observations	383

	Coefficients	***Standard Error***	***t Stat***	***P-value***
Intercept	1.348476717	0.538013114	2.506401203	0.012628526
Year	-0.081759157	0.040112136	-2.038264828	0.042239908
Course	-0.028937482	0.111692642	-0.259081361	0.795717722
ACT	0.043295844	0.021487777	2.014905662	0.044643355
Imputed ACT	0.080472067	0.128208459	0.627665812	0.530613221
Previous GPA	0.816928968	0.110680953	7.380935412	1.06164E-12
Imputed GPA	-2.554841235	0.399874859	-6.389101929	5.06089E-10
Previous Hours	0.001167984	0.001491162	0.783271069	0.433973111
Current Hours	0.001248369	0.013811451	0.090386527	0.928029372
Gender	-0.107988368	0.109429139	-0.986833748	0.324374292
Hispanic	-0.242387389	0.122323771	-1.981523186	0.048278457
Black	0.182197826	0.227439429	0.801082851	0.423601999
Asian	0.273220103	0.35863694	0.761829226	0.446651224
Native	-0.587182424	0.484309167	-1.212412369	0.226134468
International	0.498435427	0.483913651	1.030009022	0.303684097
Mediasite	1.520591172	0.170630442	8.911605418	2.3867E-17

The regression results for students in the online sections (Table 5) are similar to those of the entire dataset. Higher ACT scores make a slight difference in course grades. Previous GPA and imputed GPA have

relatively higher impacts on course grades. The size of the statistically significant coefficient estimate for imputed GPA strongly indicates that first-time freshman taking these courses online will have greater difficulty earning good grades than students with more university course experience. The coefficient estimate on the year variable is statistically significant for online students and indicate that earning higher grades in macro and micro was slightly easier in earlier years.Watching the Mediasite lectures does have a positive and statistically significant effect on online students, who can expect to earn a grade and a half higher than students who do not spend the time reviewing the recorded lectures.

Table 6-- Regression Results of Course Grade for Face-to-Face Students

Multiple R	0.6258
R Square	0.3916
Adjusted R Square	0.3609
Standard Error	0.91848
Observations	313

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	2.637704933	0.648727018	4.065970524	6.13197E-05
Year	-0.03474373	0.039863203	-0.871573957	0.384144835
Course	-0.083022079	0.113993136	-0.728307705	0.466999079
ACT	0.023583051	0.019994517	1.179475881	0.239152669
Imputed ACT	-0.347032592	0.17848155	-1.944361151	0.052795863
Previous GPA	1.282850557	0.139074466	9.224199078	5.49349E-18
Imputed GPA	-4.6022106	0.491400146	-9.365505148	1.96339E-18
Previous Hours	0.006817966	0.001772066	3.847467646	0.000146107
Current Hours	0.016493847	0.023712881	0.695564873	0.487245253
Gender	-0.147976695	0.107184213	-1.380582939	0.168445328
Hispanic	-0.034366859	0.136092158	-0.252526373	0.80080891
Black	-0.121696967	0.244139054	-0.498473985	0.618518948
Asian	-0.065136345	0.245520804	-0.265298678	0.790963426
Native	-0.582926422	0.23493589	-2.481214858	0.013646903
International	0.358840781	0.22571884	1.589768854	0.112950791
Mediasite	0.714355097	0.373126609	1.914511269	0.040515501

The regression results for students in the face-to-face sections (shown in Table 6) are similar to the other two regressions in that the cumulative GPA from the previous semester, the imputed GPA and the Mediasite coefficient estimates are statistically significant. Face-to-face students who take macro or micro as first-time freshman will tend to struggle more in earning good course grades than those who have completed previous coursework at the university level. Moreover, watching the Mediasite lectures can help face-to-face students improve their course grades by more than half a grade.

Students in the Native American group are the only ones who appear to struggle more in earning higher grades, compared to White students in the face-to-face sections.

Across the board, watching the Mediasite lectures does contribute positively and significantly to grades earned in macro and micro classes. Online students might have a greater incentive to watch the lectures since the coefficient estimate indicates grades can improve 1.5 points because of this activity.

Yet, students in the face-to-face sections also reap benefits from watching the Mediasite recordings of the lectures as evidenced by the statistically significant coefficient estimate of .71. In essence, taking the time to use the recordings indicates a higher level of student engagement with the course content. Some face-to-face students might be watching the recorded lectures because they were not able to attend class. Reports on which students use the Mediasite lectures indicate that some face-to-face students, especially athletes or others with extensive off-campus travel schedules do watch the recorded lectures for the classes they missed. Many students watch recorded lectures more than once.

This study is limited in that attendance records for students in face-to-face classes are not available for many of the sections studied. In addition, whether students are attending class or watching the Mediasite recordings, it is not possible to measure how actively engaged they are with the material. Additional research is planned that will include control groups of students in who took macro and micro courses before lecture capture was available. Measures of selection effects will be included to ascertain if the students who put the effort into watching recorded lectures are students who generally tend to do well in their classes anyway.

In spite of these limitations, this study does offer evidence that lecture capture can be an effective means of enhancing student performance in both online and face-to-face sections of principles of economics courses.