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The Impact of a Policy Change Requiring Embedded Video Lectures in Online Microeconomics Courses

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Abstract: This paper aims to study whether a pilot policy change requiring asynchronous video lectures (embedded recorded lectures) improves student performance in undergraduate online microeconomics courses. The researchers used time series regression analysis to determine whether there was a statistically significant difference before and after the intervention of recorded lectures in undergraduate microeconomic courses. Research results indicate that recorded lectures do not significantly improve student outcomes in undergraduate online microeconomics courses. The research results have implications that extend beyond the current study.

Keywords: Microeconomic courses, embedded video lectures, regional university, online courses, two-factor ANOVA, Durbin-Watson test, endogeneity, Gauss-Markov assumption

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Introduction

Economics is a challenging subject for most undergraduates, and educators have struggled with finding innovative pedagogical techniques to bolster student learning. Siegfried (1998) surveyed 236 four-year U.S. colleges and universities and found that 40 percent of the students will take at least one economics course during their college career. Relatively more students take at least one economics course at Ph.D.-granting institutions than at master's or bachelor's institutions. Siegfried & Walstad (2014) utilized the American Economic Association (AEA) and integrated into its Universal Academic Questionnaire a question stating, "How many undergraduates take at least one economics course before they graduate?" From the 337 economics departments at four-year colleges and universities in the United States, 40 percent of students receive formal undergraduate instruction in economics in some introductory course. The reporting institutions increased from 1998 to 2014, and the number of students taking an economics course remained constant.

Over 5,825,723 students were enrolled exclusively or partially in online courses in the United States in the Fall of 2020, a 93% increase in enrollment in distal education from the Fall of 2019. (Lederman, 2021). It will remain unclear for some time whether the pandemic has unequivocally altered the state of online learning. Over the last decade, higher education has seen millions of students depart from the traditional classroom and embrace a fully online learning model (Alpert, 2019). Online enrollment has grown at a double-digit pace every year, while the overall growth in higher education remains below 2% (Allen & Seaman, 2010).

Studies clearly show students remain engaged in higher education. Still, the enrollment model of preference is potentially shifting from a collocated, face-to-face classroom model to one where lecture material, assessments, and interaction are carried out via technology (Cosgrove & Olitsky, 2015). Additionally, many meta-analyses have reported that online business courses fare comparatively well compared to their classroom-based counterparts (Arbaugh et al., 2009, Sitzmann et al., 2006, Zhao et al., 2005).

Simultaneously, universities avidly seek ways to accommodate more students at a lower cost per student while increasing student learning. Collectively, today's students seek more flexible alternatives to achieving their educational goals, given the competing demands of school, work, and care for their families (Cosgrove & Olitsky, 2015). Moreover, faculty and students are finding ways to leverage technology to improve their effectiveness and efficiency, resulting in improved student learning (Goldstein & Katz, 2005; Roblyer et al., 2010).

The growth in online learning has led faculty, staff, and administrators to focus on identifying practical tools to improve performance in the classroom, leading to greater retention rates and improvements in enrollment (Bailie, 2006; Bailie, 2011). This study

illustrates how implementing a college of business pilot policy change, mandating the implementation of asynchronous video lectures in all economics courses taught online, seeks to improve overall student performance. This business school is at a regional university in the Southeastern United States. As a preliminary investigation, this study focused exclusively on undergraduate microeconomic courses. These results are essential for all players in the online learning realm and give credence to piloting similar programs in other disciplines offered online. That brings us to the research objective, which can be formally stated as follows:

To investigate whether a policy change requiring asynchronous video lectures improves student performance in undergraduate Microeconomics courses

This study has one testable hypothesis. The study's hypothesis can formally be stated as follows:

The use of asynchronous video lectures required by a policy change improves student performance in undergraduate Microeconomics courses

The following section provides an overview of related literature. This section will be followed by sections that describe the study's design and the results of executing the research methodology. The subsequent section discusses the research results, followed by a relatively short section highlighting some key limitations of this research project. The final section provides some concluding remarks, the implications of the study's results, and how these results could potentially pave the way for future research projects on related topical areas.

Review of Related Literature

Use of Recorded Video Lectures in the Online Classroom

The implementation of recorded video lectures in online Microeconomics courses is an effective strategy for improving student performance. Cosgrove and Olitsky (2015) indicate that finance and economics courses at many higher education institutions show increasing enrollment numbers in online sections. However, despite economics receiving early attention in the research stream of online learning (Chizmar & Walbert, 1999), it has lagged relative to other business disciplines in the research (Arbaugh et al., 2009).

Research finds that good use of offline video lectures and videos as part of (non-lecture) in-class activities leads to a more positive perception of educator performance (Scafuto et al., 2017). While these findings do not directly relate to the live lecture class, Sherer and Shea (2011) generalize that videos are increasingly used in higher education teaching. Others, such as Caruso and Salaway (2008), find that fewer than half of today's college students (44 percent) believe that their instructors "use information technology effectively in courses." Berk (2009) argued that students and faculty differ in their effective use of

digital media. He describes students as "digital natives," whereas instructors are characterized as "digital immigrants" who "still have one foot in the past." Thus, instructors' extent and effectiveness in integrating videos within courses warrants further study. Bishop and Verleger (2013) find that students prefer in-person lectures to video lectures and interactive classroom activities over lectures. Additionally, both Guo et al. (2014) and Toto and Nguyen (2009) suggest that students prefer shorter rather than longer videos, and shorter videos influence students' decisions to use the video again for future learning (Giannakos et al., 2016).

Guo et al. (2014) also find that students are more engaged by videos that use a "more personal feel" than those with high production values. Alpert (2019) surveyed a group of students at a large urban university, finding that 66 percent preferred videos featuring their instructor**.**

Since 2000, all but one of the studies that compare fully online with face-to-face courses in economics found that students learn the same amount or less in fully online courses. These results persist in undergraduate (Brown & Liedholm, 2002; Coates et al., 2004; Gratton-Lavoie & Stanley, 2009; Figlio et al., 2013) and graduate courses (Terry & Lewer, 2003; Anstine & Skidmore, 2005). Only Navarro and Shoemaker (2000) found improved learning performance in the form of higher final exam scores in online classes compared to face-to-face courses. Notably, Coates et al. (2004) report substantial selection bias in the students who enroll in fully online courses. Failure to account for this selection bias would have led to the conclusion that there is no significant difference in learning from the two delivery modes. Similarly, Gratton-Lavoie and Stanley (2009) found that selection bias strongly influenced their results. The raw data indicates higher mean scores for online students, but after controlling for selection bias, online teaching mode has a narrowly insignificant or negative effect on student performance (Cosgrove & Olitsky, 2015).

This study was developed to determine whether adding an asynchronous video component according to a policy change improves student performance in undergraduate Microeconomics courses offered solely in the online learning classroom. The current literature indicates outcomes are rising in online classes. In his study on student performance and outcomes, Vogel (2011) noted that online students' grades were 16 percent higher than face-to-face students. A U.S. Department of Education study concluded that "students who took all or part of their classes online performed better than those taking the same course through traditional face-to-face instruction" (Agniello, 2010). Using an experimental design, Newlin, Lavooy, and Wang (2007) found that online courses were comparable to the conventional lecture style of face-to-face classes. Rich and Dereshiwsky (2011) ran a comparative analysis among students in online and face-to-face accounting courses and found online students performed as well as those in the face-to-face course. Washburn (2012) correlated a standardized, proctored exit exam with a

learning model and found that online MBA students outperformed their in-person peers across five semesters of study. These studies are supportive of the online learning model and its outcomes.

A recent study of 26 undergraduate students enrolled in a Quantitative Methods course by (Islam et al. (2020) showed students prefer pre-recorded video lectures to live ZOOM lectures. Of this sample size, 53.8 percent chose pre-recorded video lectures, 7.7 percent chose live ZOOM lectures, and 30.8 percent chose both pre-recorded and ZOOM lectures when they chose a preferred learning mode. The pre-recorded lectures offer flexibility, convenience, and educational effectiveness (Islam et al., 2020). Ultimately, learning in a face-to-face environment, utilizing live video, pre-recorded videos, etc., requires motivation on the student's behalf. (Brockfeld et al. 2018) stated that video lectures are effective as an initial means of delivering information. Video lectures could improve the quality of teaching, focus the university lectures on the mediation of research, and even improve practical training through the possibilities that distance learning provides (Brockfeld et al., 2018).

In conclusion, there is strong evidence to suggest that, at a minimum, students enrolled in online and face-to-face classes feel greater satisfaction with courses where lecture videos are provided online (Robertson and Flowers, 2020). Still, there has not been enough research on whether students are indeed performing at higher levels due to viewing lecture videos or if there are other variables at play. Of the few studies that measure the impact of video usage on learning outcomes, most are set in the context of the traditional classroom, exploring the impact of lecture capture video as a supplemental tool or in place of a missed class. In those studies, researchers found that viewing lecture capture videos in place of or in addition to live lectures were positively correlated with higher outcomes after controlling for the academic abilities of students using GPA as the proxy (Bollmeier et al. 201; Francom et al. 2011; Harrigan 1995; Vajoczki et al. 2010; Wiese et al. 2010). Very little research has sought to measure the impact of lecture videos strictly in the online learning environment when there is no live lecture for which a video may serve as a supplement.

Policy Change Literature

Anecdotal evidence suggests that in traditional universities, policies are changed regarding distance education when someone trying to implement a course or program at a distance meets a barrier and, through persuasion, causes it to be altered or develops a workaround to the obstacle (Berge, 1998). Gellman-Danley and Fetzner (1998) state: asking tough policy questions in advance can mitigate future bureaucratic problems and roadblocks. Policies can provide a framework for operation, an agreed-upon set of rules that explain all participants' roles and responsibilities.

Onodipe et al. (2016) state the essence of an online course is the organization of learning activities that enable the student to reach specific learning outcomes. For an online course to be effective and to "provide significant learning experiences" (Fink, 2013), it needs to be designed systematically, mapping the course content to each Core Learning Outcome (CLO) to fulfill the overall Course Objective. This illustrates the concept of alignment, where critical course elements work together to ensure students achieve the desired learning outcomes (Hirumi, 2014; Maryland Online, 2014).

Unlike the decision to adopt interactive teaching methods at the instructor's discretion, administrators often shift to online instruction, with instructors responding with a change in their pedagogy. Most studies focus on how online education affects students, but the use of different teaching methods for online instruction has implications for faculty too. The change in teaching time may be significant, and one could not understand a professor's choice without considering start-up costs, which may be substantial. (Allgood et al. 2015).

As with a policy change mandating the use of asynchronous video lectures embedded into a microeconomics course, there are initial start-up costs to the professor concerning technology, closed-captioning, video, audio/sound, quality content, upload capabilities, and delivery. The school of business does provide essential technical support to faculty incorporating these changes into an online class. However, with any technological aspect, there are lag times, and issues are often outside the professor's control.

In this pilot study, professors were not limited to one medium to record lectures. They were encouraged to use Microsoft Teams, but others chose to use Zoom or Screen-Cast-O-Matic.

The Use of Time Series in a Policy Change Literature Review

This paper examines the hypothesis that implementing asynchronous video lectures in an online curriculum improves student learning outcomes. The hypothesis was tested using time series analysis on the Microeconomics course student performance data.

A time series is a sequence of values of a particular measure taken at regularly spaced intervals over time. Segments in a time series are defined when the sequence of measures is divided into two or more portions at change points. Change points are specific points in time where the values of the time series may exhibit a change from the previously established pattern because of an identifiable real-world event, a policy change, or an experimental intervention (Wagner et al., 2002).

The choice of each segment's beginning and end depends on the intervention's beginning and end, with the possible addition of some pre-specified lag time to allow the intervention to take effect (Lee & Augusto, 2021). In this paper, the “before” segment measured student performance before the policy change of “required asynchronous video lectures in online microeconomics courses, and the “after” measured post-policy change results.

To determine the outcomes, we undertook an interrupted time-series analysis (ITSA) (Bernal et .al, 2017 & Xiao et .al, 2021) to evaluate the association between the reference time point and the outcomes from Fall 2017 to Fall 2021. Also referred to as segmented time-series regression, ITSA is applied to statistically measure changes in various levels and trends in a postintervention period compared with a pre-intervention period (Ishikawa et .al, 2022).

Research Design

This section of the manuscript is divided into two subsections. The first subsection discusses the sample selection process. The second discusses the empirical methodology employed to obtain the research results.

Sample Selection

This study evaluated the integration of asynchronous video lectures in undergraduate, principles-level Microeconomics courses at a public university in the southeastern region of the United States. The course is part of the general studies curriculum for all students enrolled. The university has a network of locations within the state and is also international in scope. It has a diverse student body in traditional, nontraditional, and emerging electronic formats. Due to ever-shrinking state budgets, the university utilizes online classes to reduce faculty costs per student and meet the constraints of students. Asynchronous video lectures effectively provide classroom-quality instruction in an online learning environment to improve student performance.

The data collected for this study was acquired over five years ranging from Fall 2017 through Fall 2021. The academic calendar for online courses runs on five, nine-week terms instead of a traditional sixteen-week semester. A fall semester consists of Terms 1 and 2, a spring semester consists of Terms 3 and 4, and the summer is Term 5. The Economics Department Chair instituted the policy implementation of video use in the online classroom effective Term 1, Fall 2021. This policy change is the determining factor in analyzing students' performance in online Microeconomics courses within this study.

The study analyzed student performance based on letter grade breakdowns and overall pass/fail rates in online Microeconomics courses before and after the policy change. Data were obtained by the university registrar, and no student identifiers were used in this study; only the letter grade breakdown and the term a student was registered were taken into account.

Table 1, in Appendix A, contains the summary statistics for online microeconomic course data filtered by term as previously described. It shows the total number of courses included in the "Before" and "After" data, where "Before" constitutes the period prior to the policy change and "After" constitutes the period after the policy change. The table shows the

distribution of letter grades and the number of students enrolled in each section of the course for both the "Before" and "After" groups. In reviewing Table 1, it should be noted that ECON 101 is not the actual course number for the undergraduate Microeconomics course; rather, it is a "dummy" course number utilized by the researchers to protect the identity of the university that is the subject of this manuscript. Furthermore, all courses included in Table 1 are conducted fully online.

Table 1: ECON 101 Grade Distribution - Before and After Policy Change

Term	A's	B's	C's	D's	F's	F.A.'s	# Enrolled
Before							
17/T1	3	7	12	2	2	0	26
17/T2	2	8	8	4	3	0	25
18/T1	1	14	14	12	2	1	44
18/T1	3	3	10	7	5	0	28
18/T2	1	17	14	2	2	0	36
18/T2	2	1	2	1	2	0	8
18/T2	0	0	0	0	1	0	1
18/T3	3	10	19	2	2	0	36
18/T3	1	10	7	7	5	0	30
18/T3	0	0	1	0	0	0	1
18/T4	1	7	9	0	2	0	19
18/T4	2	1	3	0	0	0	6
18/T4	1	1	0	0	0	0	2
18/T5	2	7	5	3	3	0	20
19/T1	2	6	18	7	0	5	38
19/T2	9	13	11	0	4	0	37
19/T2	1	0	0	0	0	0	1
19/T3	4	11	16	5	7	0	43
19/T3	4	14	21	3	3	1	46
19/T4	9	12	13	4	9	0	48
19/T5	2	5	18	7	4	2	38
20/T1	3	16	13	5	5	0	43
20/T2	14	20	6	6	2	0	48
20/T2	0	0	1	0	0	0	1
20/T3	8	18	8	4	1	0	39
20/T4	19	10	9	0	0	1	39
20/T4	1	0	0	0	0	0	1
20/T5	7	18	14	0	5	0	45
20/T5	1	5	2	0	3	0	11
21/T3	4	9	18	2	4	1	39

21/T3	0	0	1	0	0	0	1
21/T4	16	16	12	1	1	1	47
21/T5	4	14	10	1	6	0	35
21/T5	1	0	0	0	0	0	1
After							
21/T1	2	4	12	2	7	2	29
21/T1	13	16	9	0	5	0	43
21/T2	2	3	10	2	3	0	21
21/T2	2	10	11	2	3	0	30

Empirical Methodology

This paper examines the hypothesis that implementing asynchronous video lectures in an online curriculum improves student learning outcomes. The hypothesis was tested using time series analysis on the Microeconomics course student performance data. Again, the novel data set omits any student identifying information and only includes the aggregate number, per course, of enrollees, passes, fails, and each letter grade (A through D). Student performance across all Microeconomics courses taught during the specified terms were divided into the following categories: Pass, A, B, C, D, and Fail ("F"). Table 1 above reflects this division criteria in the summary statistics.

Data were filtered based on performance classification (letter grade). Time series regression analysis was conducted on each separate performance classification with the following model:

$$Y_t = s(t) + \varepsilon_t$$

Where Y_t reflects student performance, as a percentage, at time *t*. The variable *s(t)* is the term effect, deseasonalized by dividing performance by the seasonal component. Finally, ε_t contains the random errors at time *t*. For each classification, one-year (five-term) moving averages were calculated to arrive at the trend component. Student performance was then regressed onto course term. The final step of the analysis forecast the series one year (12 months or five course terms) into the future, through the end of 2022.

Research Results

Figures 1 through 6 depict the series of percentages for the given performance classification (Pass, A, B, C, D, and Fail) as well as the one-year center moving average and the five-course-term forecast. Video lectures were implemented in Term 1, 2021 (the beginning of August). Table 2 contains the calendar dates for each of the corresponding five terms at the regional university throughout the year.

Table 2: Academic Calendar by Term

Term	Dates
1	August 9 to October 10
2	October 11 to December 12
3	January 10 to March 13
4	March 21 to May 22
5	May 31 to July 31

Figure 1 contains the series of student pass percentages from Term 1, 2017, through Term 2, 2021. The results failed to support the stated hypothesis as the overall percentage of student passes in the online Microeconomics course decreased after video lectures were implemented. The volatility of student passes is meager compared to many of the other performance classifications and is likely due to the pass variable comprising four other variables (A, B, C, and D). The pass results were not statistically significant.

Figure 1: Student Passes, Microeconomics

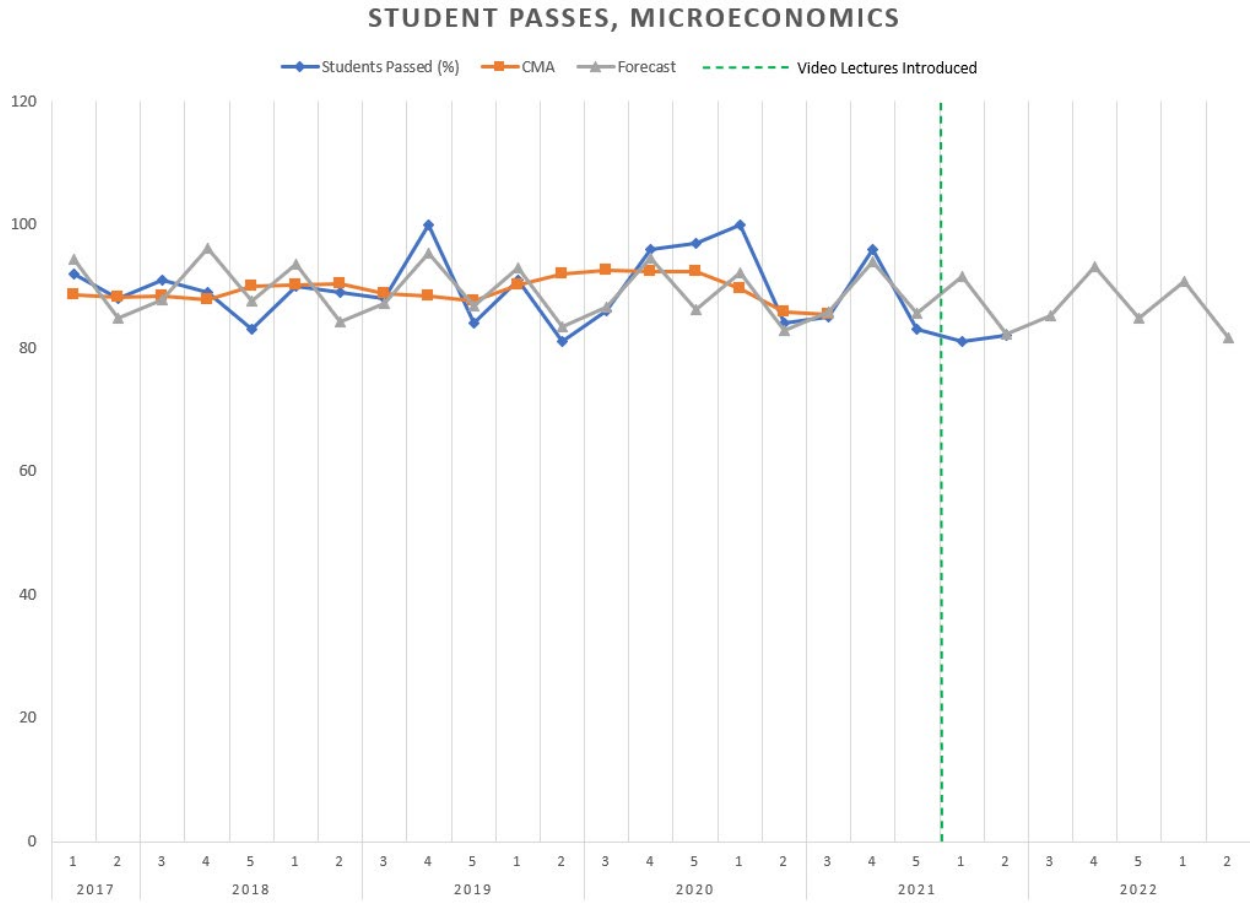


Figure 2 depicts the student A-grade percentages in the online Microeconomics courses at the regional university. There is a noticeable increase in the percentage of students who received A-grades following the implementation of video lectures. The volatility is greater than in the student pass percentage chart (Figure 1) and, similar to the student passes, the results for A-grades were not significant.

Figure 2: Student "A" Grades, Microeconomics

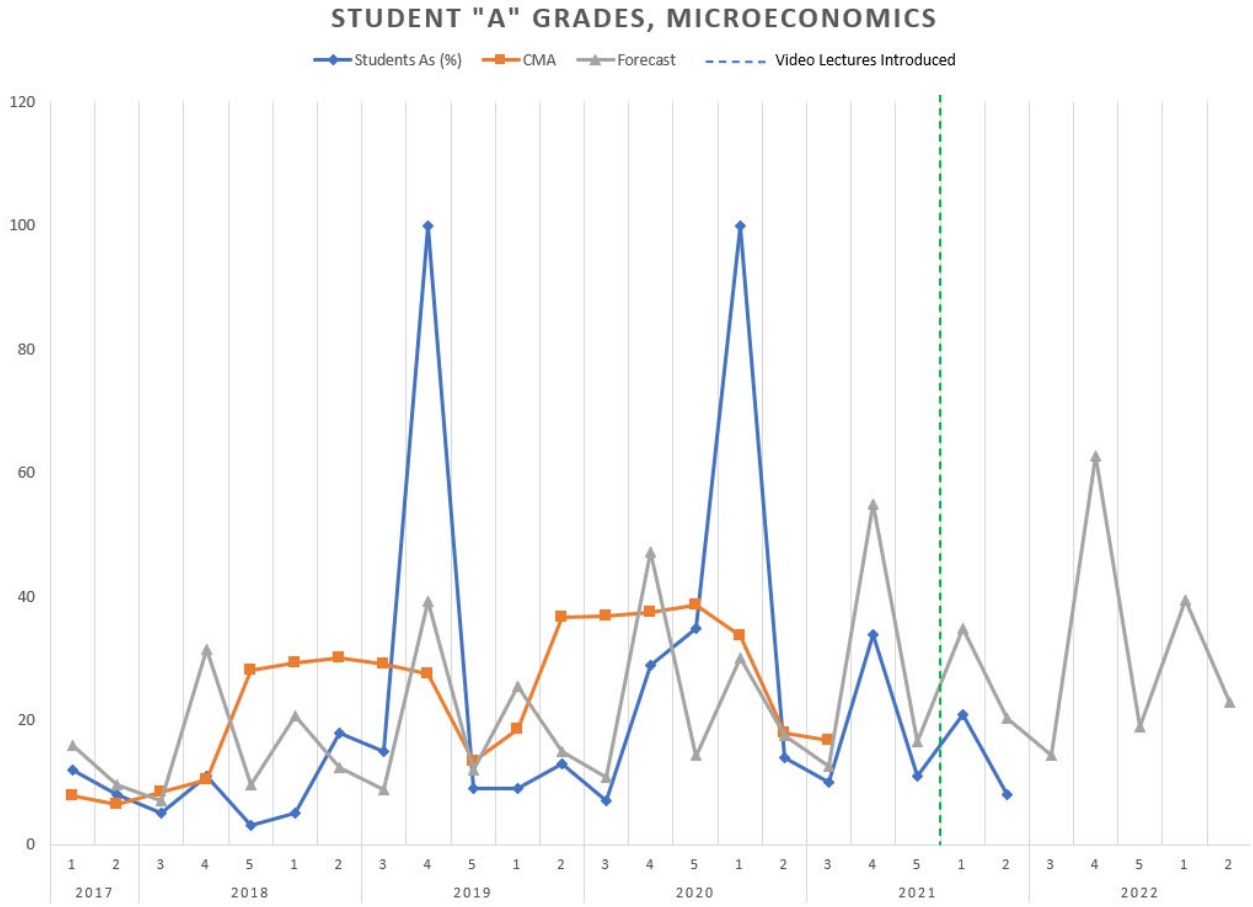


Figure 3 contains the student B-grade percentages. The five-term forecast in Figure 3 levels off and has a very slight positive effect. Term 5 clearly contains the highest B-grades, both in the historical data and the forecast. Like the earlier results, student B-grades were not statistically significant. Due to low enrollment, there were two outliers in the B column where no students received B scores during Term 4 of 2019 and Term 1 2020, which may also account for the lack of significance.

Figure 3: Student "B" Grades, Microeconomics

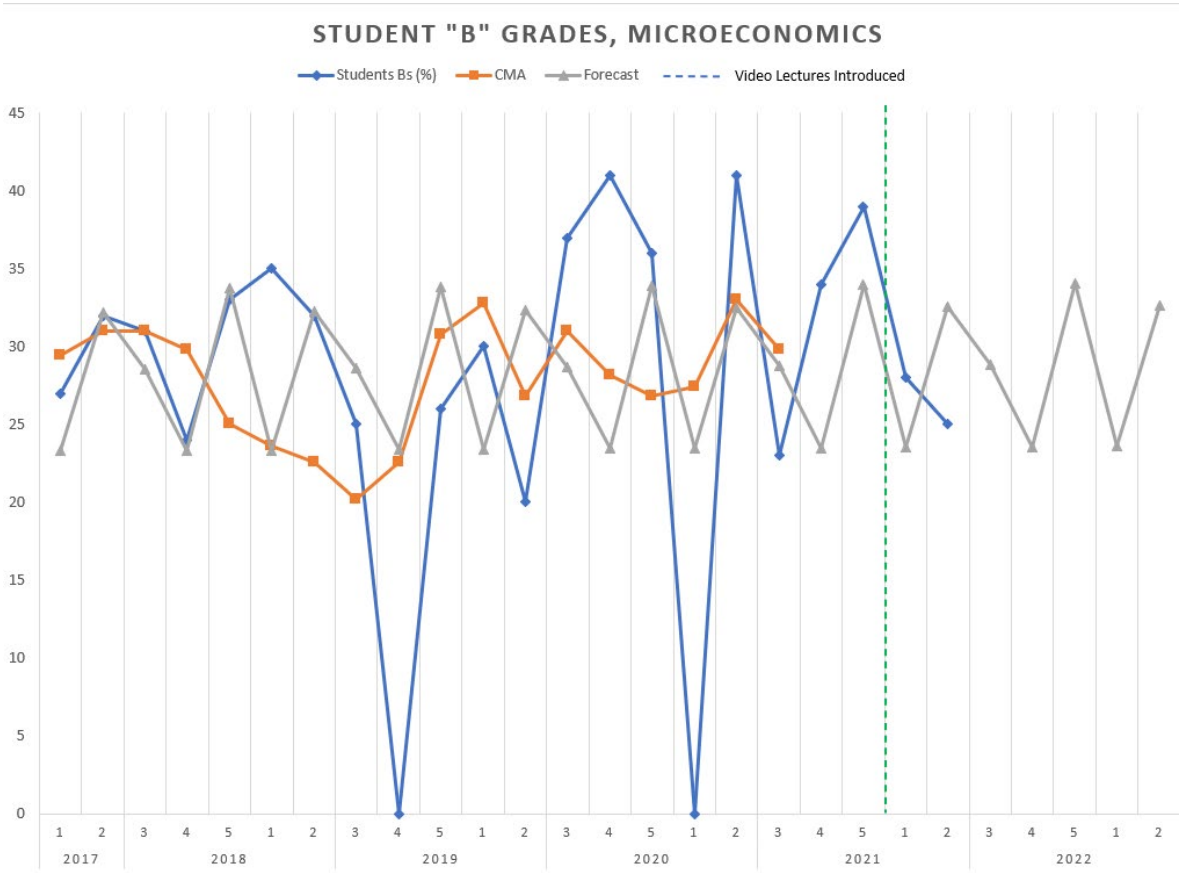


Figure 4 marks the student C-grade percentages in the Microeconomics courses. There is a steady decline in Cs throughout the observed period, with a slight uptick in Cs following the asynchronous video lecture implementation. Yet, these results were also not significant.

Figure 4: Student "C" Grades, Microeconomics

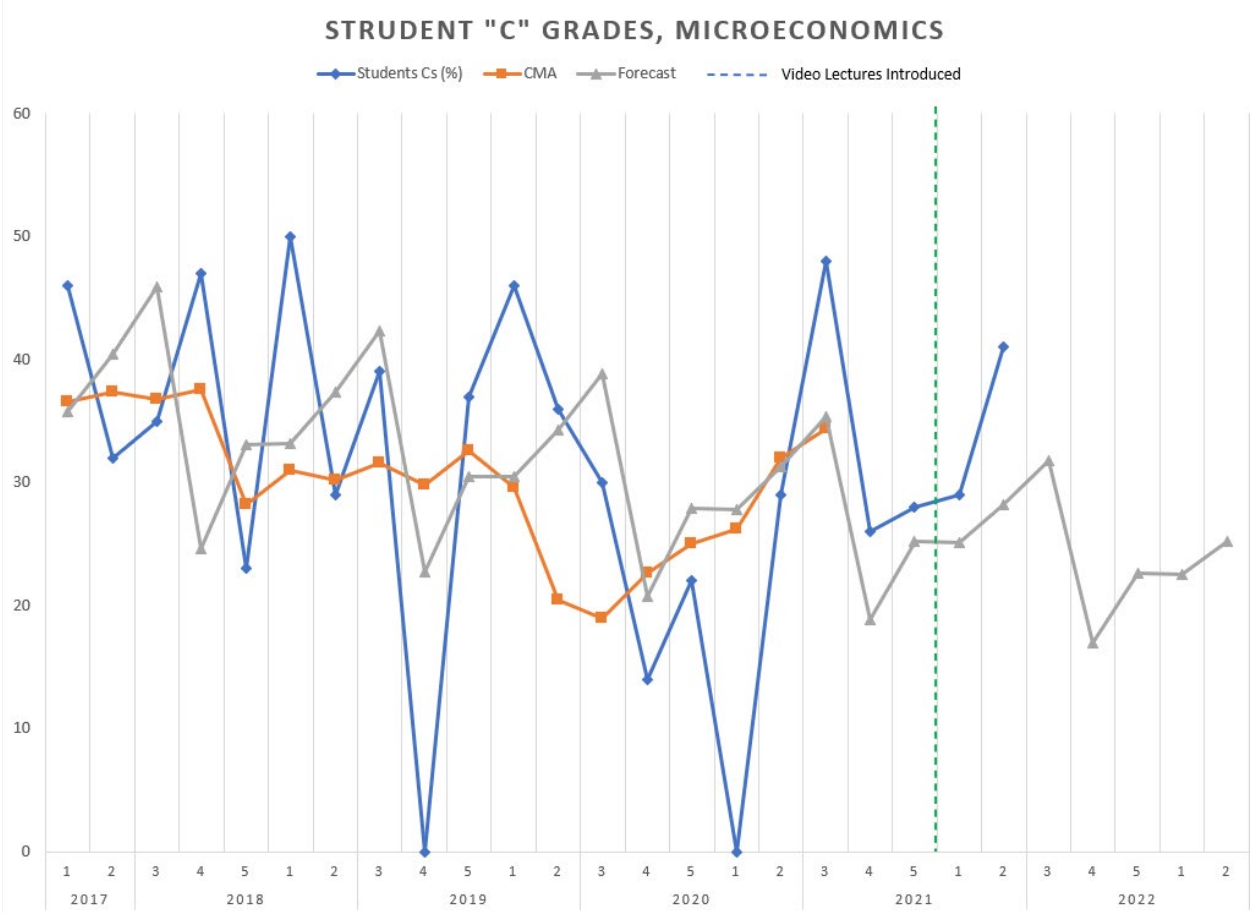


Figure 5 shows the student D-grade percentages before and after video lecture implementation. From 2017 through 2019, there was a steady decline in D-grades. However, 2020 saw sharp increases in students who barely passed Microeconomics. Yet, the projection shows that eventually, the number of D-grades will become near-zero. These results were statistically significant at the 95% level.

Figure 6 tell the opposite story. Student fails tend to be up during terms 2 and 5 and down during terms 1 and 4. Following the implementation of video lectures, the number of student fails remains the same for one term then drastically decreases. The five-term projection, however, suggests student fails will return to pre-implementation levels during term 2 of 2022. These results were not statistically significant.

Figure 5: Student "D" Grades, Microeconomics

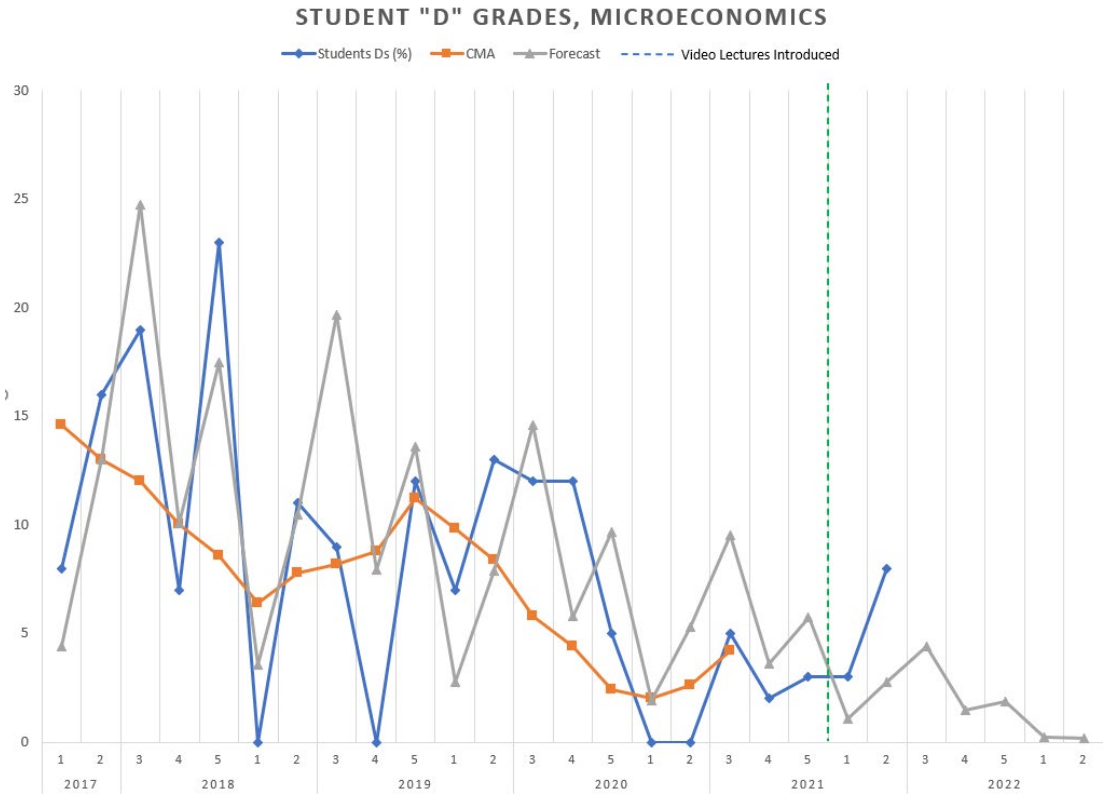
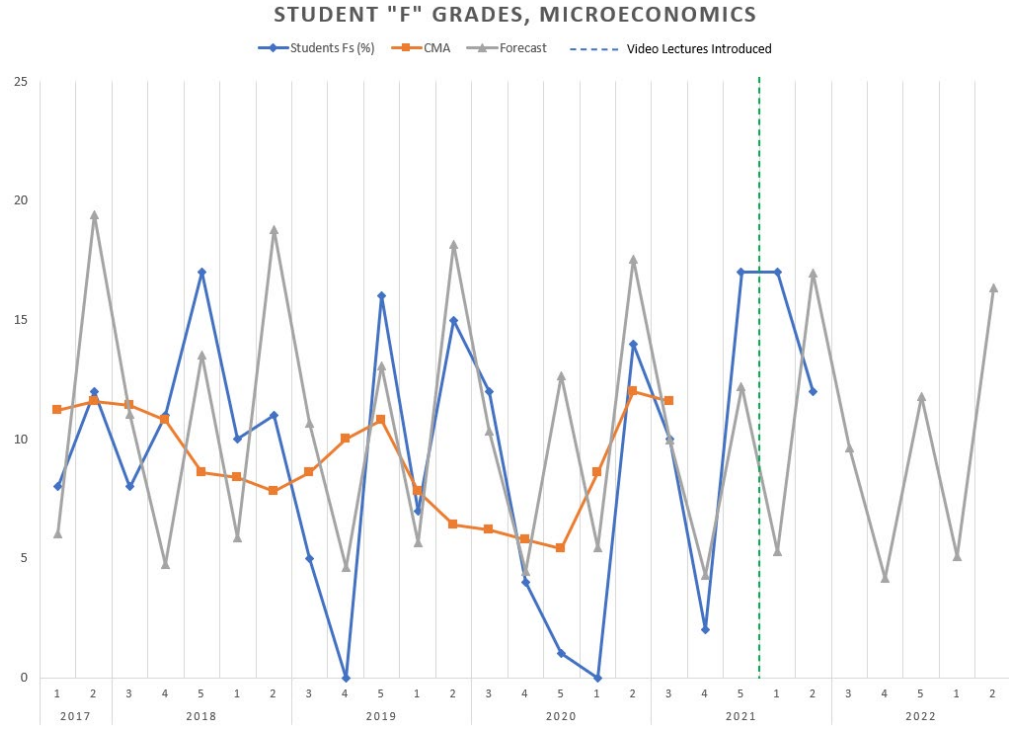


Figure 6: Student "Fails", Microeconomics



It is critical to note that, with the exception of D-grades, none of the classification variables were statistically significant. Table 3 shows the significance status of each student performance classification: coefficient (with significance) and standard errors.

Table 3: Significance Level Based on Performance Classification

Performance Classification	Coefficient[Significance]	Standard Errors
Pass	-0.14	2.13
A	0.81	0.67
B	0.01	0.4
C	-0.56	0.51
D	-0.63*	0.26
Fail	-0.07	0.26

Of the six performance classifications (Pass, A, B, C, D, and Fail), only D grades was statistically significant, and only at the 95% level. Even if the p-values were halved on the argument that the tests should be one-tailed, this would change none of the significance results. Despite this, and in combination with the fact that the Pass variable was endogenous with four of the other classifications (A through D), post-hoc robustness tests were conducted on the data.

Robustness

Several robustness checks were made throughout the study's analysis. The first check constituted using percentages rather than raw grade numbers. Different courses saw radically different enrollments; Thus, student performance was calculated as a percentage to account for the enrollment variance.

In terms of post-hoc checks, correlation and analysis of variance (ANOVA) tests were performed on the raw data. Not surprisingly, there was strong correlation between each of the student performance classifications, with Pass positively correlating with A but negatively correlating with B, and C, D, and Fail. A positively correlated with B and D but negatively correlated with C and Fail. B positively correlated with all the other variables. C correlated positively with D and F, and D positively correlated with F. The magnitude of correlation was, overall, fairly weak with the strongest correlation within the entire matrix—that between Pass and Fail—equaling -0.93, rounded. Table 4 contains the Correlation Matrix between student performance classifications.

Table 4: Correlation Matrix: Student Performance Classifications

	Pass	A	B	C	D	F
Pass	1					
A	0.06	1				
B	-0.35	0.23	1			
C	-0.54	-0.01	0.38	1		
D	-0.31	0.06	0.26	0.15	1	
F	-0.93	-0.08	0.39	0.44	0.35	1

The second post-hoc test was ANOVA two-factor without replication to determine whether the means in each of the classification columns (Pass, A, B, C, D, and Fail) were statistically significant. The correlation post-hoc test indicated that there was strong correlation between the different classifications, which is concerning because of a potential endogeneity issue with regressing both Pass and its component parts (A, B, C, and D) onto time *t*. Table 5 shows the ANOVA results.

Table 5: ANOVA Two-Factor without Replication:
Student Performance Classifications

Variation Source	*S.S.*	*df*	*M.S.*	*F*	*P-value*	*F crit*
Rows	3,196.70	21	152.22	2.3	0	1.68
Columns	10,787.42	4	2,696.85	40.81	0	2.48
Error	5,550.98	84	66.08			
Total	19,535.10	109				

Interestingly, there was a significant difference between the different rows (mean student performance classifications within the same term). Also, there was an incredibly significant difference between the columns (the mean percentages across all terms), suggesting that the different columns are distinct and that any endogeneity in the time series model does not violate the corresponding Gauss-Markov assumption in any meaningful way.

The final robustness check determined whether autocorrelation existed in the data. Most of the time series outputs (Figures 1 through 6) contained identifiable, oscillating patterns in student performance for that classification variable, possibly due to autocorrelation. A Durbin-Watson test was performed to detect any autocorrelation in the data. The test produced a test statistic of 1.53. Given the number of terms in our sample (n = 22) across the different classification variables (k = 6), the critical values at the 95% confidence level are 0.77 (dL) and 2.09 (dU), respectively. Thus, the null hypothesis of Durbin-Watson—

that autocorrelation exists—was rejected at the 95% level. The null was also rejected with 99% confidence (dL = 0.59, dU = 1.8).

Discussion

The preceding section presented the results obtained by executing the study's chosen methodology. These results are supplemented by numerous tables and figures, which are located in Appendix A and B, respectively towards the end of the manuscript. This section provides a discussion of the research results.

Before proceeding further with this section, the researchers would like to reiterate the study's objective and hypothesis. This study's primary objective is to investigate whether a policy change requiring the use of embedded video lectures improves student outcomes in undergraduate microeconomics courses. The study hypothesized that this policy change improves student performance in undergraduate microeconomics courses. The study's hypothesis was tested utilizing the methodology articulated in the *Empirical Methodology* subsection of the **Research Design** section.

Table 2, in Appendix A, should give the reader an idea of how the terms are structured at the university that is the subject of this manuscript. The dates listed pertain to academic year (AY) 2021-22. Although the exact dates can vary from AY to AY, they were in the same timeframe during the study period (August 2017 to December 2021).

The data for this study can be classified into two categories: Before and After. The "Before" category pertains to undergraduate microeconomic courses that were taught prior to the policy change that resulted in the implementation of the recorded videos whereas the "After" category pertains to undergraduate microeconomics courses that were taught after the policy change. As a result, the data for the "Before" category consisted of all online undergraduate microeconomic courses taught from Term 1 of 2017 through Term 5 of 2021. The data for the "After" category consists of all undergraduate online microeconomic courses taught during Terms 1 and 2 of 2021 at the university that is the subject of this manuscript. The policy mandating the implementation of asynchronous video lectures in online courses took effect in Term 1 of 2021.

Table 1, in Appendix A, shows the distribution of letter grades for both categories alluded to in the preceding paragraph. As stated previously, the "Before" category includes all online microeconomic undergraduate courses that were taught from 17/T1 to 21/T5; the "After" category includes all online microeconomic undergraduate courses taught during 21/T1 and 21/T2. Table 1 shows the distribution of letter grades, as well as the number of enrollees in each section of the course for both categories. The statistical analysis, as discussed in previous sections, involved differences in pass/fail rates between the two categories. "Pass" includes the total number of A, B, C, and D grades, whereas "Fail"

includes F grades only. Hence, in 17/T1, which constitutes the first row of the "Before" category, 22 enrollees were classified as "Pass" and two enrollees were classified as "Fail."

Table 1 also includes a column labeled F.A. This stands for "Failure to Attend." Some students register for a course, but do not participate in any course activities. The F.A. column captures these students and in a majority of course sections are listed as 0; in other words, a majority of sections, of the online undergraduate microeconomics course at the university that is the subject of this manuscript, did not have students who registered for the course, but did not attend the course in actuality. At any rate, the column labeled F.A. is included in Table 1 for informational purposes only and was not utilized in the statistical analysis.

Tables 3 to 5, in appendix A, show the results of the quantitative analysis. They depict the results of the statistical analysis, correlation matrix and the results of the two-factor ANOVA, respectively.

Based on the empirical analysis, only the results for letter grade D was significant at conventional levels of significance. The results for all other letter grades, including the Pass/Fail analysis, were insignificant at conventional levels of significance. In short, the research results do not support the study's postulated hypothesis.

As stated in the Research Results section, figures 1 to 6, in Appendix B, depict the series of percentages for the performance classifications of Pass, A, B, C, D, and Fail, respectively. These figures also provide the one-year center moving average and the five-course-term forecast. The information presented in the figures is consistent with the results of the statistical analyses presented in the tables. Only the results for letter grade D was statistically significant at conventional levels of significance; in other words, the number of students receiving a grade of D decreased after the implementation of the embedded videos.

Although the literature, on this topic, generally tends to support the usage of embedded videos in online courses in an attempt to improve student outcomes, these results are not necessarily conclusive. For instance, Berk (2009) indicated that the effectiveness of the usage of embedded videos in online courses warrants further investigation. Furthermore, Guo et al. (2014) and Toto and Nguyen (2009) stated that students preferred videos that were shorter in length. Finally, the results of the study by Alpert (2019) indicated that students generally prefer videos featuring their instructor as opposed to "canned" videos.

Taken collectively, the literature on this topic indicates that one cannot make a blanket statement regarding the effectiveness of embedded videos with respect to improving student outcomes in online courses; in other words, this is not a settled issue by any stretch of the imagination. This is owing to the fact that there are video specific issues, such as video length, that need to be taken into account.

Another issue to consider is student aptitude for the subject matter. Microeconomics is a required course, in the undergraduate business curriculum, and as such students have to take the course whether they want to or not; hence, many students enrolled in the course may not have a natural aptitude for the subject matter and, as a result, intervention techniques, such as the use of embedded videos in the course, may not make an appreciable difference in the student's overall performance in the course. This issue is further elaborated with a personalized story in the succeeding paragraph.

One of the authors of this manuscript has an undergraduate degree in electrical engineering. The individual, who is the subject of this story, did not have an aptitude, or interest, for the subject matter and that is the reason he/she switched majors when entering graduate school. The university at which this individual completed his/her engineering degree offered a variety of intervention tools to improve student performance with videos being one of them; another widely utilized tool, by students, was free tutoring services. The student in question took full advantage of all available intervention tools, including videos related to course content, but it made no appreciable difference in his/her performance in the course. As stated in the preceding paragraph, intervention tools may not necessarily help improve performance, in a given course, if students do not have a natural aptitude and/or interest for the subject matter in question.

To sum up the arguments advocated above, research results do not support the study's hypothesis; however, that does not automatically invalidate the results of the study. As indicated in the Literature Review section, the effectiveness of the use of embedded videos in online courses warrants further investigation. This is owing to the fact that there are numerous issues, such as natural aptitude for the subject matter, that need to be taken into account in order to make a definitive argument regarding the impact of embedded video lectures on student performance in online microeconomics courses.

Limitations

All research projects have limitations and this study is no exception. One of the limitations of this study is the fact that the data for the "Before" and "After" categories were not evenly distributed. The researchers had several years of "Before" data whereas only two terms of "After" data was available at the time of the research. However, this issue was beyond the researcher's control since the policy change only took effect in August 2021 and this research project commenced in February 2022.

Another potential limitation is the fact that this study was limited in scope. It only analyzed undergraduate online microeconomics courses at a regional university located in the Southeastern part of the United States. In other words, the focus of this study was one subject matter at one university. It did not include other online courses, either at the undergraduate or graduate level, or courses taught at other universities.

As articulated previously, the research results do not support the study's stated hypothesis which in effect advocated for increased student performance following the policy change that resulted in the implementation of embedded videos in all online courses taught within the College of Business. However, that does not necessarily mean that the results are not valid for reasons stipulated earlier. It is also entirely possible that the results of this study are a statistical artifact which is an issue in many research projects that cannot be ruled out as a limiting factor even if the results are statistically significant. Regardless, the issues addressed above need to be further investigated.

Conclusions and Implications

In Term 1 of 2021, the College of Business at a regional university located in the Southeastern portion of the United States implemented a policy that mandated all online courses must incorporate embedded video lectures into the course. This study investigated whether this policy change impacted student performance in online undergraduate microeconomic courses taught by faculty at the university's business school. The study hypothesized that embedded videos would improve student performance in undergraduate microeconomic courses. This research project involved rigorous quantitative data analysis covering the period from August 2017 to December 2021. The period from August 2017 to July 2021 constituted the time period before the policy change, and the period from August to December 2021 constituted the period following the policy change. By and large, research results are not consistent with the study's stated hypothesis.

Although research results do not support the study's hypothesis, they are not necessarily invalid. The Discussion and Limitations sections have advocated several reasons for the results being what they are. These, and other potential confounding effects, deserve further investigation. Further investigation of all potential confounding effects could lead one to conclude that the research results are valid and it is the hypothesis that is flawed and needs to be revisited. Furthermore, an extensive review of related literature has indicated that the impact of utilizing embedded videos on student performance is not a settled issue and, as such, warrants further investigation.

There are numerous avenues for future research projects in related topical areas. As stated in the Limitations section, this study was limited in scope because it only considered undergraduate online microeconomics courses at a regional university in the S.E. United States. It did not consider other courses, universities, or countries. Expanding the scope of the study is a significant research extension to the current study, as it would indicate whether or not the results of this study are supported by broadening the scope of the investigation into this area. Furthermore, an investigation into the issues discussed previously that resulted in the study's testable hypothesis not being supported could potentially be a topic for a future research project. Another potential research project is to

investigate whether incorporating Quality Matters (QM) improves student outcomes in online courses. QM is described in the succeeding paragraph.

The QM Rubric is a set of standards used to evaluate the design of online and blended courses. The Rubric is complete with annotations explaining the standards' application and the relationship among them. A scoring system and set of online tools facilitate the evaluation by a team of reviewers. The focus of QM is to promote student learning and is essentially a faculty-driven peer review process.

This study also has some practical applications. Many higher education institutions are grappling with the issue of the instructor-student interface in courses that are not taught in an in-person format. In this regard, any policy initiative's primary objective would be to convey to students that online courses are not correspondence courses. In keeping with this objective, many universities have implemented a variety of delivery mechanisms, such as embedded video lectures, as discussed in this manuscript, or live lectures that are delivered via platforms such as Microsoft Teams, Cisco WebEx, and Zoom. The results of this study might give universities some pause and cause them to reevaluate the effectiveness of such intervention strategies as a tool to improve student outcomes in courses that are not taught in a face-to-face format.

It is worthy of mention this study was a preliminary investigation into this topical area. As such, this research project focused on one subject area, microeconomics, at a regional university located in the Southeastern part of the United States. In doing so, it has provided some insight into the effectiveness or lack thereof of a policy requiring embedded video lectures in online courses. This should serve as a stepping stone for future research projects pertaining to content delivery in online courses. Hence, that is the primary contribution, of this study, to the academic literature.

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