Student-Produced Videos Can Enhance Engagement and Learning in the Online Environment

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Abstract
Student engagement in online learning remains a challenge for the design of effective coursework. Additionally, few analyses have focused on student-produced activities in the online mode or upon how such class activity affects student subgroups differently. We conducted a randomized design experiment with student video production at a large public university. Student background and behavior factors were measured in two online surveys, which were combined with course assessment data. Because of the small sample size, we observed few significant differences in learning outcomes across the experimental treatment and control sections, except with regard to a value-added measure. We suggest that student learning was likely most concentrated on concepts around which students produced the videos. And when students were divided by incoming language proficiency, non-native English speakers had higher perceived learning; but when grouped by incoming GPA, those with higher previous grades actually achieved higher test scores and pass rates.

Keywords: student-generated videos, peer learning, demographic factors, random design

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Online education offers opportunities to enhance student success particularly when it (1) allows universities to increase class offerings if space constrains the number of classroom sections, (2) brings education access to students who cannot come to campus to take classes, and (3) enhances the performance of subgroups of student learners who engage better in a digital environment (Betts, Hartman, & Oxholm, 2009; Clark, 2009; Lorenzo & Moore, 2002). Although learning outcomes usually exhibit no statistical difference across modes, research and observations in cross-disciplinary venues (i.e., *The Chronicle of Higher Education*, *The American Journal of Distance Education*) mention the higher dropout rates of students taking an online version of coursework compared to a traditional lecture section. One reason for this could be lower student engagement in online-classes compared to face-to-face classes. Another possible issue is how students with different demographic backgrounds react to an online class.

Designing effective pedagogies within online coursework, thus, must involve enhancing student engagement and satisfaction. For example, collaborative learning and enhanced social presence (joint participation in interactions) build community in asynchronous learning networks and, as a result, increase student engagement in online classes (Rovai, 2000). Chang and Smith (2008) find higher levels of student–student interaction (through chat sessions, discussion boards, and other projects) to be a significant predictor of satisfaction; Dixson (2010) links these interaction factors to student course engagement. Activities in which students make presentations and teach each other are effective practices highlighted in the National Survey of Student Engagement (NSEE, 2010).

Personal and demographic characteristics may affect students' learning in the online environment. The impact of student computer self-efficacy, prior online experience, and feelings regarding online course delivery appears mixed (Puzziferro, 2008; Jan, 2015). Bolliger, Supanakorn, and Boggs (2010) suggest that background factors (e.g., gender and online experience) affect student motivation, preferences, and ultimately satisfaction with pedagogies such as podcasts; Hargittai (2010) uses regression analysis to find that gender and race are significant predictors of higher levels of Web-use skills and the access necessary to succeed in an online class. Zhang (2015) finds that students of higher socioeconomic status are more likely to utilize some learning technologies (e.g., Khan Academy). There is not much research examining how demographic background impacts different stages of online learning, such as preparedness, class behavior, learning outcome, and satisfaction.

Multimedia design components generally involve an audio or video file of content placed online for course material delivery. Faculty- or professional-generated multimedia components are common for online or hybrid course design. Most research on faculty-generated multimedia components in online courses shows that it leads to positive results in actual and perceived student learning (see Kay, 2012, for a review). An exception is Dupange, Millette, and Grinfeder (2009), who found that a (nonrandomly selected) group of students viewing videos did worse than nonviewers in a communication studies course; additionally, the viewing levels were lower for nonwhite students and higher for those expressing positive attitudes toward online education and computer literacy. A Dupuis, Coutu, and Laneuville (2013) study finds that lower GPA students demonstrated the largest gains in test scores after watching the videos and that the learning gains were concentrated around particular exams/concepts.

The innovation of student-generated course material represents a novel recent addition to online courses (Guertin, 2010; Bolliger et al., 2010; Kay, 2012). In general, this effort builds upon the use of student discussion forum activities in the online class mode to enhance interaction and cognitive engagement (see for example Zhu, 2006). Multimedia moves the interaction to a more visual and auditory presentation of the discipline concepts. Students producing podcasts gain not only subject knowledge but also professional presentation skills, while the broader group gains peer learning through these student-generated videos.

The literature has documented student-generated multimedia activities primarily in the science and business disciplines. Surveys show different positive impacts (teamwork, communication, satisfaction) of podcasting in engineering (Alpay & Gulati, 2010), information technology (Bolliger & Armier, 2013), and geography (Anderson, 2013). Student responses indicate increased perceived learning in a variety of business disciplines (Armstrong, Tucker, & Massad, 2009; Alon & Herath, 2014; Orus et al., 2016). And nursing students exhibit greater

development of core competencies in sections with self- and peer-recorded videos, compared to traditional lecture classes (Pereria, Echeazarra, Santamaria, & Gutierrez, 2014).

Moryl (2013) summarized an assignment in which viewing of professionally produced podcasts increased perceptions of economic understanding. Later, Moryl (2016) documented how student groups created their own YouTube videos of economic concept presentations. Our project differs from Moryl (2013, 2016) in that we focus on upper division economics coursework and individual efforts. We include a somewhat larger random sample and analyze the effects of student video production on both satisfaction, motivation and actual quantitative learning achievement.

Our particular strategy represents an example of active learning and student peer provision of learner support and feedback, which could influence student success directly and/or indirectly through its contribution to student course engagement and satisfaction. Yet it is a component that requires some technical skills, fluency in English, and comfort with public presentations. So analysis of student background characteristics and their possible interplay with the component can shed light on the observed actual learning outcomes. In the analysis below, we focus on differences in preparation, behavior, and outcomes not only by treatment status but also by previous academic performance (GPA), gender, underrepresented status (e.g., Hispanic), Pell Grant status, whether English is the student's first language, and mother's educational attainment.

We examined whether differences exist among students along demographic background and whether these differences correlate to differences in terms of their readiness for online education, behavior in the class, and performance. We discuss a student-generated video project to increase student learning and retention in online education. Ideally, it could promote student engagement with course content, and provide supplemental learning materials for the class, which could benefit particular groups of students desiring more visual tools. The following were our two research questions:

1. Does the student-generated video component increase student engagement with the class and improve learning outcomes?
2. Are there any differences among groups of students with varied demographic backgrounds in terms of online education readiness, engagement in the online environment, and/or learning outcomes and satisfaction in online classes?

To answer these questions, we implemented a random experimental design in spring 2016 with two online class sections of the same course, with one using the self-generated video component and the other not using it.

Methods

Participants

This study used an experimental design based on the random assignment of 113 ever-enrolled students across two online sections of a managerial economics class. Randomization occurred 72 hours before the first day of the spring 2016 semester. This course is required for all students who want to get a BA in Business Administration. Students enrolled in the class are either at the junior or senior level. The random design reduced possible biases from the correlation between unobservable factors, student behavior, and the outcome variables by providing exogenous variation in treatment. Sample selection bias could occur if, when students chose to participate in a class with oral presentations, hidden characteristics behind their likelihood to

participate also affected test scores. Students were assigned to each class section using an Excel random number generator, with verification of the comparability of the samples based upon their incoming academic qualifications (see Appendix A). Some students dropped the class (with three late adds) during the first two weeks of the class before the video activity began. Ultimately, 97 students remained enrolled in the class and received surveys; 87 took the final exam. The first survey had 84 respondents (an 87% response rate) and the second survey 78 respondents (an 80% response rate) across both sections. Response rates were encouraged by extra credit incentives.

Student Background

In general, data from the first survey suggests students were somewhat older (average 25 years [*SD* = 4.91]) and worked more than 24 hours/week (*SD* = 16.60). There were slightly more women (41% men, *SD* = 0.50). Most of the students had lower income levels (71% Pell Grant eligible, *SD* = 0.46) and definite past experience (average 5.05 courses, *SD* = 3.84) in online education. They had diverse ethnic backgrounds (33% Hispanic, the rest reported as non-Hispanic and primarily as Asian or Caucasian) and moderate incoming grades (mean incoming GPA = 2.91, *SD* = 0.40). Almost half of the students' mothers did not complete college (*SD* = 0.50). Seventy-nine percent of the students also reported English as their primary language (*SD* = 0.41). These characteristics were similar across class sections, except that survey results showed that students in the treatment sections could be coming in with somewhat better English skills, while those in the control group were more likely to self-identify as Hispanic. There were no significant differences across the treatment/control groups with regard to work hours or previous online experience, although students with Pell Grants (financial aid) tended to have fewer work hours than those without the grants. There was some overlap between the students in our six background categories; for instance, there was a significant positive correlation between male gender and Hispanic ethnicity and between English being the native language and a mother's completing college. Very few physical or otherwise disabled students enrolled in the classes, with no differences across sections.

Measures

In this study, we included measures on demographics, students' perception of their preparation for online classes, their perception of the class, and actual performance data. Demographic information was collected through the Office of Institutional Research, and students' perceptions were measured through Likert-scale survey questions drawn from the *DETA Research Toolkit 1.0* (Joosten & Reddy, 2015). Actual performance was measured through students' grades on various online activities (on the Moodle and McGraw-Hill Connect websites). Variable definitions are provided in Appendix B. Characteristics of survey items were developed after consultation with experts, a literature review of key instruments, and expert-developed classifications to group items (see Joosten & Reddy, 2015). The first survey included 22 variables from the *Toolkit* related to background personal and academic characteristics as well as six variables linked to student preparedness and readiness for the course. Among the demographic/academic background variables, incoming GPA and native English language ability could give students an advantage in class performance, as would the reality of fewer work hours and greater previous online course completion. In the analysis below, we focus on six binary dimensions by which the student population can be characterized: low versus high incoming GPA, gender, Hispanic versus non-Hispanic, Pell Grant status, native English language, and mother's college completion versus noncompletion. Within each dimension, the population is divided into two subgroups.

The first survey included the preparedness and readiness questions (measures of experience in distance education, access to technology, online skills proficiency, technology familiarity, online learning efficacy, and self-directedness). These factors could be relevant to how the class activity affects the outcomes of each student. For instance, a student with greater computer self-efficacy could produce a better quality video more efficiently, thereby impacting their own and peer outcomes.

The second survey focused on student behavior and perceptions at the end of the course. Students were asked about their perceived course activity challenge, course interactivity, and active learning behaviors in the course, as well as their perceptions of the course social presence and engagement. The second survey also included questions on student outcomes, including scalar and open-ended queries regarding how student performance, learning, satisfaction, and success were impacted by the course.

Among the measures in the questionnaires, we found that the following six variables (Table 1) were most relevant to this study and provided the most internal consistency as measured through Cronbach's alpha.

Table 1.

Initial Survey Background Response-Item Consistency

Variable group	Cronbach's alpha statistic	Items
PRESKILLS (1-7) Online Skill Proficiency	.972	7
PRESE (1-6) Online Learning Efficacy	.861	6
PRESD (1-4) Self-directedness	.914	4
ENGAGE (4-8, 10, 12-15) Engagement	.965	10
LEARN (1, 3-8) Perception of Learning	.973	6
PERFORM (1-5) Perception of Performance	.868	5

Since these questions were on a Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*), a higher number represents a more favorable response. For the purposes of this research, where we want to look at differences among subgroups, we first calculated a total score for each student for each variable area in Table 1. We then determined an average score (between 1 and 5) for each student. The questions (listed in Appendix B) meant that a higher number on the Likert scale implied a student felt they had a greater degree of online skill proficiency, efficacy, or self-directedness. At the end of the class, a student choosing agree or strongly agree would be indicating more engagement and a higher perception of learning and performance in the class.

Other variables measured by the instructor included student performance on module online homework and quiz activities, as well as treatment student scores on the video activity and ratings for each module. The online textbook–homework bundle provided access to a class-specific website for the graded problem sets and the optional Learn Smart concept mastery exercises. (This publisher's website also tracks student engagement through time, frequency, and success of activities.) The final exam provided the primary learning assessment measures (correct multiple-choice question numbers and points, worked problem scores) and the value- added score. This

score included 10 questions administered as a pretest (before students opened the content website) and as a posttest, with those same questions incorporated within the final exam. The content of the 10 questions included key concepts from across the coursework: marginal analysis, the value of a firm, linear demand function interpretation, own-price elasticity, cost measures, principal-agent concerns, market structure measures, monopoly profit maximization, oligopoly game-theory analysis, and second-degree price discrimination.

Procedures

Both the treatment and control student groups had unique Moodle websites with common study activities (online lecture content and quizzes), and common exams were administered online or on campus at separate locations. The two groups were also placed in two separate McGraw-Hill homework websites. The same final exam for both sections was 30% of the class grade. The online student-generated problem-solving video project comprised 10% of the grade in the treatment sections, with the other activities (quizzes, homework) scaled for comparability (i.e., in the treatment group, each homework earned up to 10 points and each quiz up to 5 points; in the control group, each homework earned up to 15 points and each quiz up to 7.5 points, so the points in the treatment were multiplied by 1.5).

Each student in the treatment section was asked to produce a narrated video showing the steps to solve a typical exam multiple-choice problem. Students were given a window in which to choose the topic; after that, the instructor assigned problems randomly. Students were provided a guideline sheet outlining the options (a narrated PowerPoint slideshow, a YouTube video, etc.) and examples created by the instructor and the publisher. Sample topics presented in the student videos included (a) the steps to calculate full economic price under a price ceiling, (b) the steps to calculate own-price elasticity from a linear demand function, and (c) the steps to calculate the optimal two-part pricing scheme for a firm with market power. Each student created a video and posted it in a discussion forum link by Thursday of the relevant module. Other students viewed it and provided ratings and comments in the forum. Each student earned up to 25 points (5% of the class grade) for the video produced and up to 5 points for each of five ratings of other students' videos (viewing of additional videos was encouraged and open throughout the semester). Assignment grading was based upon a rubric providing 60% of the weight for video content, 20% for how other students rated the video, and 20% for the video's technical quality to encourage serious efforts at peer teaching.

Data Analysis

In the outcomes below, we employ a mixed methods approach to data analysis. We use quantitative tools (cross-tabulations, *t*-tests, *F*-tests, and ANOVA) to analyze the data trends in survey and instructional data across the treatment and control groups, as well as within demographic subgroups. We also include qualitative comments to provide context to the trends observed. All calculations were undertaken in SPSS-24.

Results

Differences in Students' Perception of Their Online Readiness

First, we examine the subgroup differences in terms of students' perceptions of their skills and readiness for the online class. Table 2 shows the overall section average values for each of the response question areas with standard deviations in parentheses. In no case was the summary index

significantly different across the randomly sorted treatment and control sections. Most students felt they possessed strong skills and self-directedness for online coursework. Yet very few believed strongly in the efficacy of online coursework. Most students answered *strongly agree* or *agree* on the Likert-scale questions (4, 5) on the preparedness and readiness questions included in the first survey. A few significant variations appear across the focus subgroups with regard to the average responses on specific frequency-based questions (PREPSKILLS). (See Appendix B for specific question wording.) Table 2 shows that women (particularly in the treatment section) and non–Pell Grant students had significantly stronger beliefs about the efficacy of online courses (differences in bold). Nearly all students had taken several online courses in the past.

Table 2.

Selected Student-Learner Readiness Characteristics From First Survey

Section	Online skill proficiency index PREPSKILLS_A1-A7 (average across 5-level scale on each question)	Online learning efficacy index PREPSE1-6 (average across 5-level scale on each question)	Self-directedness index PREPSD1-4 (average across 5-level scale on each question)	Previous online courses
Total class	4.26 (0.98)	3.35 (0.72)	3.86 (0.74)	5.04 (3.84)
Treatment section	4.24 (1.03)	3.38 (0.80)	3.84 (0.74)	5.07 (4.41)
Control section	4.28 (0.94)	3.31 (0.62)	3.88 (0.76)	5 (3.26)
Focus divisions				
Incoming GPA				
2.5 and above	4.23 (1.04)	3.32 (0.71)	3.38 (0.75)	5.08 (4.00)
Below 2.5 range	4.43 (0.57)	3.51 (0.78)	4 (0.75)	4.77 (2.86)
Gender				
Female	4.27 (0.96)	**3.48 (0.71)***	3.87 (0.68)	4.71 (2.67)
Male	4.24 (1.04)	**3.16 (0.70)**	3.85 (0.835)	5.53 (5.12)
Self-identified Hispanic				
No	4.14 (1.10)	3.34 (0.63)	3.83 (0.69)	4.88 (3.37)
Yes	4.47 (0.65)	3.34 (0.89)	3.91 (0.85)	5.54 (4.62)
Pell Grant eligible				
No	4.34 (0.88)	**3.63 (0.81)***	4.04 (0.60)	5.35 (3.80)
Yes	4.24 (1.03)	**3.29 (0.66)**	3.83 (0.83)	4.88 (3.52)
Native English speaker				
No	4.10 (0.97)	3.31 (0.71)	3.67 (0.69)	3.82 (3.71)
Yes	4.29 (1)	3.36 (0.73)	3.91 (0.76)	5.27 (3.82)
Mother college education				
No	4.32 (0.78)	3.35 (0.76)	3.78 (0.83)	5.11 (4.18)
Yes	4.18 (1.23)	3.35 (0.69)	3.97 (0.55)	5 (3.55)

Note: Means and standard deviations reported.
* $p < .10$. ** $p < .05$ using a two-sided *t*-test with equal variances not assumed.

Table 3.

Selected Differences in Course Behaviors and Qualitative Outcomes

	McGraw-Hill Engagement Index*** (0-10)	Survey Engagement Index (ENGAGE 4-8, 10, 12-15, reverse items corrected; average across 10)	Student Perception of Learning Index (LEARN 1, 3-8, reverse corrected; average of 6 items, 5 points each)	Student Perception Performance Index (PERFORM 1-5, reverse corrected; average across three items)	Student's expected grade in the course: % expecting B or better
Total class	5.38 (1.59)	3.29 (0.85)	3.58 (0.81)	3.53 (0.76)	36 ≥ B or better
Treatment section	**5.49 (4.68)****	3.34 (0.73)	3.63 (0.80)	3.52 (0.79)	43
Control section	**4.68 (1.92)**	3.24 (0.96)	3.53 (0.82)	3.52 (0.79)	29
Focus divisions					
Incoming GPA					
2.50 and above	5.16 (1.84)	3.31 (7.77)	**3.68 (0.66)****	3.58 (0.69)	38
Below 2.50	4.69 (1.77)	3.21 (1.16)	**3.14 (1.22)**	3.27 (0.98)	29
Gender					
Female	5.42 (1.54)	3.39 (0.73)	3.66 (0.77)	3.54 (0.66)	33
Male	5.34 (1.74)	3.13 (1.00)	3.42 (0.86)	3.49 (0.89)	45
Self-identified Hispanic					
No	5.32 (1.59)	**3.13 (0.74)****	3.54 (0.78)	3.51 (0.71)	**42****
Yes	5.43 (1.64)	**3.59 (1.04)**	3.59 (0.91)	3.57 (0.89)	**26**
Pell Grant eligible					
No	5.19 (1.15)	**3.69 (0.63)***	3.76 (0.76)	3.39 (0.70)	33
Yes	5.25 (1.63)	**3.24 (0.90)**	3.51 (0.85)	3.53 (0.78)	40
Native English speaker					
No	5.25 (1.65)	3.39 (0.68)	**3.78 (0.46)***	3.53 (0.70)	44
Yes	5.48 (1.60)	3.27 (0.91)	**3.49 (0.89)**	3.52 (0.80)	38
Mother college educated					
No	5.26 (1.48)	3.18 (0.94)	3.53 (0.90)	3.62 (0.82)	32
Yes	5.47 (1.66)	3.38 (0.76)	3.59 (0.71)	3.37 (0.68)	43

Note: Means and standard deviations reported.
* $p < .10$. ** $p < .05$ using a two-sided *t*-test with equal variances not assumed (for all columns except far right) or a Pearson χ^2 test (for far right column).
***external engagement measure based on time and success on activities

Student Behavior and Perception Differences

We were able to observe student behavior through class activities, websites, and survey items. Points earned on the module quizzes and Connect homework were virtually the same across treatment and control sections. We brought in additional data from the McGraw-Hill website, including the ungraded practice Learn Smart exercises and an overall engagement score; in both cases students in the treatment section took more advantage of the publisher homework website.

This external source shows a significantly higher degree of engagement recorded in the treatment section (5.49 points vs. 4.68 points, $p = 0.03$).

In Table 3 no significant differences appear in the behavior survey questions between the treatment and control sections (ENGAGE, LEARN, PERFORM). However, there are different behavior and perception differences across subgroups of students. Students coming into the class with higher grades tended to use the publisher website to a greater degree (as measured by the McGraw-Hill Engagement Index). The index was higher overall and for this subgroup in the treatment section ($p = 0.08$), for native English speakers ($p = 0.07$), as well as for Hispanics in the treatment section (vs. the control; $p = 0.03$). The survey engagement question shows a somewhat different trend. The group without Pell Grants was more likely to express agreement with the survey engagement questions. When the students were grouped by ethnicity, Hispanic students were more likely to express agreement with the survey engagement questions. In a separate ANOVA analysis, we found a significant positive interaction effect between treatment and Hispanic ethnicity on the ENGAGE average index ($F = 2.74$, $p = 0.10$). Question items mattered; for instance, to the engagement question "I was absorbed in the experience," 35% of the students chose the 4–5 (*agree* or *strongly agree*) on the Likert scale, with the highest positive responses by Hispanic students (43%, compared to 28% for non-Hispanics, $\chi^2(1) = 8.63$).

Table 3 also shows that those for whom English was not their first language expressed higher perceived learning. Almost 69% of the non-native English speakers answered *agree* or *strongly agree* on nearly all of the items (compared to 43.3% of the native speakers). The video presentations may have helped language learners since they could watch the media as many times as they wanted. However, when the students were considered along a different dimension (incoming GPA), those with lower grades tended to have lower perceived learning from the class and lower grade expectations. And non-Hispanics had higher grade expectations, since they more frequently stated their grades would be at the top end of the seven categories (A, A-/B+, B, B-/C+, C, C-/D+, D). This differential for this subgroup was particularly strong in the treatment section, where 52% of the students expected a B or better, while only 29% expected this in the control section.

Additionally, open-ended questions were included in the second survey. The first question asked students in the treatment section to "describe if and how the learning activity (class video presentations) changed your engagement in this class." Most responses favored the activity, highlighted engagement/learning aspects of the activity, and confirmed the effect of peer learning. Some examples include the following:

> "The class video presentation exercise changed my engagement in the class in a positive way it gave myself and other students accountability to interact by giving our personal feedback and explaining our problems."
>
> "It was useful to better understand problems I couldn't solve on my own."
>
> "The video presentations were pretty helpful in increasing engagement within the class. Creating the video really made you learn the subject, while watching others' videos made sure that I would keep tuning in every week."

However, there were still a few negative comments (five of the 48 participants). These negative comments could help design the activity better in the future:

> "I personally do not think it helps but only creates busy work in class and only is there to get points for participation."
>
> "The videos did not fully change my engagement in class. Comments on the videos stimulated discussion but it was mostly surface level and one sided. I think most students posted their one comment for a grade rather than in-depth discussion. From all the assignments in this course, it was the one I thought about the least."

Students in the treatment section answered a second open-ended question: "Describe if and how the learning activity (class video presentations) changed your learning experience." Again, most responses were positive, with comments such as the following:

> "The video presentation exercise changed my learning experience in this class in a positive way because before creating my video, I ensured I fully understood the concept so it was teachable and presented clear enough when it came to making my personal presentation."
>
> "It changed my learning experience because online classes can be pretty limiting in participation, but this presentation was a great way to participate as well as learn from."

Quantitative Student Learning Outcomes

Table 4.

Actual Learning (Quantitative Outcomes)

Students taking final	Treatment (n = 44)	Control (n = 43)	p-value
Class GPA	2.55 (0.82)	2.31 (0.78)	.95
Total class points (% of 500; grades assigned on 50 pts.)	74.10 (19.37)	72.43 (19.70)	.675
Pass rate (0,1; 1 if C or better)	72.9%	67.3%	.55
Final exam word problems points (0-30)	25.59 (4.04)	25.43 (3.43)	.842
Final exam multiple-choice points (0-120)	65.97 (14.59)	61.28 (13.69)	.124
Pretest average (0-10)	3.34 (1.60)	3.60 (1.84)	.69
Posttest average (0–10)*	**5.59 (2.11)**	**4.78 (1.90)**	.067
Value-added (post-pre)* (range -10 to +10)	**2.25 (2.44)**	**1.27 (2.72)**	0.083

Note: Means and standard deviations reported.
* $p < .10$. ** $p < .05$ using a two-sided t-test with equal variances not assumed (for all columns except far right) or a Pearson χ^2 test (third row)

Table 4 provides data on the learning assessment from class grades and scores on the cumulative final exam. Students in the treatment section tended to earn more class points overall, receive a slightly higher grade, and passed the class more frequently, although the differences were not significant. However, students in the treatment section did perform significantly better on certain final

exam multiple-choice items. Their learning on the key concepts (especially market equilibrium, elasticity, and market structure) included on the pretest and posttest did improve. This is to be expected since the student video work demonstrated how to solve such multiple-choice-type problems. There was a significant 1-point increase on the value-added scores of students in the treatment section.

We next turn to how different subgroups of students performed on the learning measures. Table 5 suggests that background factors matter on the student's final exam performance. When students were grouped along their previous grades, those with higher incoming GPAs were more likely to pass the class and earn a better grade. All final exam measures were higher for them. Hispanic students tended to earn lower grades and do somewhat worse on the final exam multiple-choice items. Being a native English language speaker provided a significant boost only on the written part of the final exam. In addition, when the students were divided by whether or not their mother completed college, we found that those without college-educated mothers tended to earn lower overall grades and perform worse on the multiple-choice items of the final exam. We also looked at learning gain through the difference between pre- and postquiz questions. Students who are not first generation scored 1.5 points higher on the value-added questions, particularly in the treatment section ($p = .07$). We also observed that students with higher GPAs tended to have higher learning gains than students with lower incoming GPAs.

Table 5.

Performance Outcomes by Subgroup

	Pass rate	Class grade GPA	Final word problems	Final multiple choice	Pre versus post value-added
Total class	70%	2.43 (0.80)	25.51 (3.73)	63.65 (14.20)	1.78 (2.61)
Focus divisions					
Incoming GPA					
2.5 and above	**74%****	**2.52 (0.78)****	25.72 (3.53)	64.25 (14.71)	**1.89 (2.57)***
Below 2.5	**50%**	**1.96 (0.80)**	24.43 (4.63)	60.54 (11.06)	**1.21 (2.83)**
Gender					
Female	71%	2.44 (0.72)	25.59 (3.29)	63.85 (13.84)	1.73 (2.73)
Male	78%	2.46 (0.90)	25.74 (1.54)	64.50 (15.56)	1.91 (2.59)
Hispanic					
No	80%*	**2.56** (0.84)**	25.76 (3.73)	**65.98* (14.54)**	2.02 (2.79)
Yes	62%	**2.15 (0.61)**	25.27 (3.5)	**60.39 (2.54)**	1.20 (2.26)
Pell Grant					
No	66%	2.41 (0.58)	**23.92** (3.7)**	60.69 (14.57)	1.82 (2.24)
Yes	76%	2.50 (0.83)	**26.18 (1.44)**	65.47 (13.64)	1.60 (2.76)
Native English					
No	78%	2.42 (0.65)	**24.09** (3.8)**	64.84 (14.80)	1.00 (2.48)
Yes	73%	2.47 (0.84)	**25.95 (3.7)**	64.08 (14.50)	2.1 (2.66)
Mother College Education					
0 = no	68%	**2.30* (0.79)**	25.18 (3.82)	62.36 (13.39)	**1.00** (2.66)**
1 = yes	78%	**2.60 (0.79)**	25.66 (3.49)	66.57 (15.10)	**2.73 (2.44)**

Note: Means and standard deviations reported.
*$p < .10$. **$p < .05$ using a two-sided t-test with equal variances not assumed (for all columns except far right) or a Pearson χ^2 test (for far left column).

The question remains whether the video production activity could have changed how these background factors related to the actual learning outcomes. In separate subsample mean tests, a few significant differences appeared for the value-added learning outcome of the students of that group in the treatment section compared to the students of that group in the control section. For instance, students with higher incoming GPAs and non-Hispanic students did better in the treatment section than they did in the control group. In the univariate analysis of variance of Appendix C (Test of Between-Subjects Effects), there were no significant interaction effects between the treatment intervention and each specific subgroup characteristic. However, the treatment alone did explain a large part of the variation in student value-added scores across non-Hispanic and native English language groups; their mean value-added scores were over 1 point higher in the treatment section (compared to the control) in both cases (p = .08 and p = .09, respectively).

Discussion

Summary of Results and Connection to the Literature

Student podcasting and video production can improve engagement and learning in online coursework. Here, we implemented a randomized experiment with upper division students enrolled in the same class, in sections with and without video production. By looking at class performance, we observed better class performance and learning gains in the treatment section when compared with the control section. This observation provides some support for our assumption that student-generated videos will increase engagement and learning.

Video production could have been a challenging activity for some groups. Those without technical skills or English as primary language could feel less prepared at the beginning of the semester; however, over time we observed that actual language-based learning gaps were reduced. Student academic preparation for the class (incoming GPA, meeting the prerequisites, etc.) remained crucial. But interestingly, on item-response questions, most students surveyed did not feel less prepared or lacking the necessary skills for the online course experience.

The main findings of this study are summarized below:

1. The students had diverse demographic and behavioral characteristics, particularly regarding their incoming GPA levels, gender, ethnicity, first-generation learner, Pell Grant status, and command of the English language. All subgroups of students participated in the treatment activity nearly equally. But each of these subgroups had somewhat similar self-expressed beliefs in their online skill proficiency and self-directedness, as well as the efficacy of online learning. Like the student body analyzed in Hargittai (2010), we observed that better off students (i.e., without Pell Grants) had completed more online coursework and possessed higher perceived online skills. (And non-English native language students were concerned about their skills and had taken the smallest number of online courses.) We note that women expressed the greatest belief in the efficacy of (and enthusiasm for) online coursework, while those with college-educated mothers scored higher on the index of self-directedness.
2. Three engagement trends were examined: student work on the McGraw-Hill Connect website, student performance/effort on other class activities, and student responses to specific survey questions. Only in the first case did students in the treatment section

demonstrate higher levels of engagement. Students in the two treatment groups did not behave significantly differently regarding participation in various class activities or on the survey-based questions. Qualitative comments suggest students generally enjoyed the activity, with some split over the value of viewing and rating other students' work. This does not follow some other studies of student podcasting (Anderson, 2013; Armstrong, Tucker, & Massad, 2009; Moryl, 2016) in which very high student enthusiasm was noted. Our results are more similar to those of Bolliger and Armier (2013), with a strong majority of participants noting increased perceived learning. Among the other inherent background factors, better off students expressed the highest level of engagement with the overall course on the survey response measures; and the study here follows the trend noted in Zhang (2015) in which Hispanic students had higher agreement responses to particular questions around attention focus in the course.

3. Although there were few perceived differences in the performance and learning response questions, survey results show non-Hispanic and higher GPA students expecting to do well in the class. Qualitative comments implied that the experimental treatment students perceived that their learning had increased. In actuality, final grade assignment and actual learning were not much higher across treatment groups or subgroups. A small but significant treatment versus control difference was detected in the final posttest questions and value-added measures, particularly for higher GPA and/or non-Hispanic students. These gains are lower than those observed for the student podcasting work in marketing (Orus et al., 2016) and contrast the improvements for lower GPA students noted in Dupuis et al. (2013) for molecular biology. For our sample, the students' mothers' college education was most associated with actual learning achievements. There were no interaction effects between treatment group and student background factors.

Taken together, these findings suggest inherent background factors affect a student's trajectory through online learning preparation, specific assignments, processes, and outcomes. Our students with low incoming GPAs had taken fewer online courses previously, were less engaged in the course, had lower grade expectations in both sections, and ultimately achieved lower actual learning outcomes. A similar path was observed for the group of students whose mothers had not completed college. On the other hand, students with English as a native language expressed higher online experience but lower perceived learning than those without an English background; however, the native English speakers did better on some of the actual learning measures. These paths appeared across both class sections (with and without video production).

It is worth recalling that the student video production activity represented a small part of the overall grade and was done alongside other learning activities (whose effectiveness is not discussed here). We posit that the precise learning improvement from the activity comes down to enhanced mastery of specific concepts in the class, rather than overall learning of the material. To verify this, we further explored possible specialized learning from video production. The final exam included several word problems and 48 multiple-choice questions, with subgroups related to each learning module of the class. There were four questions for each of the modules related to early content (overview, supply and demand, elasticity, production and cost, incentives, and market structure measures), and eight questions per module for the new areas not covered on the earlier midterms (perfect competition/monopoly, oligopoly, and advanced pricing strategies). The module/chapter for which each student produced a video was identified, without those module-specific questions removed from the "overall learning" group. So, for instance, students who

produced a problem-solving video on the Chapter 3 material would have their scores on the total four questions related to Chapter 3 compared to the remaining questions (44 possible questions). We compared the proportion of each student's correct "material-related" questions to the overall question material. Generally, 62% of the students did better on the questions related to their activity content, compared to the overall questions included on the final exam (average 52% correct) (t = 1.88; p = .16). Yet this pattern was clearest on the review material earlier in the semester, compared to the more advanced sections later in the semester.

Limitations

The research design focused on the incremental (marginal) impact of a new activity, with all other aspects of the course design in place. The comparison courses were designed to provide moderate incentives for participating in the new video activity while maintaining the integrity of the other course components and exam assessment measures across both the control and treatment sections. Very small (marginal) impacts were determined. If the student-generated assignment had represented a larger part of the class (e.g., each student producing three videos for 30% of the grade), we would expect to have seen larger learning gains.

And the analysis is based on a small sample size and only on included multiple-choice-type items for problem-solving skills. An exercise in which a larger number of students produced videos to address case study or essay-type questions may provide different results. Finally, the experiment took place in the context of students' (and the instructor's) learning curve on the assignment and video production process. If students participated in the same activity in a subsequent course (such as a major capstone), different learning gains could perhaps be observed.

Future Research Directions

Here we explored the association between the video intervention activity in the class and student learning outcomes. We discussed how this association could vary across different student subgroup variations, which could serve as both controls and drivers in the process. Future research should explore the direct and indirect causation between student background factors, class interventions, and learning outcomes. That is, a path analysis approach could link student background factors (indirectly) to exam scores and performance through the measures of engagement and perceived learning/performance. Additionally, two-stage regression analysis would treat the processes sequentially.

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Appendix A: Background Institutional Data

Beginning of semester background characteristics of treatment-control groups, spring 2016		
	Treatment (n = 56)	Control (n = 57)
Enrolled credits	13.80 (3.30)	12.62 (3.07)
Incoming GPA	2.59 (0.59)	2.66 (0.59)
Low incoming GPA (= 1 if below median 2.50)	54%	41%
Grade points ECON 201	2.75 (0.69)	2.83 (0.77)
Grade points Math 135	2.63 (0.93)	2.69 (1.02)
Met prerequisites (1 = yes)	0.88 (0.33)	0.83 (0.38)
Note. Means and standard deviations reported		

Appendix B: Variables Definitions

Variable ID	Definition	Item	Coding
Gender	Student-reported gender	With which gender do you identify?	1 = Male 0 = Female (recoded) 99 = Unknown
Age of student	Student self-reported years of age	How old are you?	Continuous in years
Ethnicity	Student-reported ethnicity	Do you identify as Hispanic?	0 = Non-Hispanic 1 = Hispanic 99 = Unknown
First generation	Student report of mother's highest level of education achieved	What was the highest school completed by your mother or parent 1?	1 = Middle school/jr. high 2 = High school 3 = College or beyond 99 = Other/unknown
	Student report of father's highest level of education achieved	What was the highest school completed by your father or parent 2?	1 = Middle school/jr. high 2 = High school 3 = College or beyond 99 = Other/unknown
Pell Grant eligible	Student's report of eligibility	Are you eligible or have you received a Pell Grant?	Yes = 1 No = 0 (recoded) Unknown = 99
Time commitment	Self-reported paid hours worked/week	How many hours do you work per week on average?	Continuous (hours worked last week), don't know, or none
	Self-reported number of credit hours in past	How many credits did you take last semester?	Continuous (number of credits enrolled last semester) or don't know
Native English speaker	Self-reported as English as student's first language	Is English your first language?	1 = Yes 0 = No (recoded)
Preparedness and readiness	Student's self-reported experience in distance education	How many previous online courses have you taken?	Continuous (number courses)

	Student's self- reported preparedness or readiness for distance education based on one's beliefs about their skills proficiency, comfort with technology	I am able to easily access the Internet as needed for my studies; I am comfortable communicating electronically; I am willing to actively communicate with my classmates and instructors electronically; I feel that my background and experience will be beneficial to my studies; I am comfortable with written communication; I possess sufficient computer keyboarding skills for doing online work; I feel comfortable composing text on a computer in an online learning environment	• 7 items used (of 16) • 5-point Likert scale • *Strongly disagree* = 0 to *strongly agree* = 5; collapsed to *strongly disagree*/*disagree* = 1; *neutral* = 2; *agree*/*strongly agree* = 3 • 0 reverse coded
	Student's self- reported beliefs about online learning	I am motivated by the material in online activities; Learning is the same in class and at home online; I feel that I can improve my listening skills the same working online as in an-person class; I believe that learning online is more motivating than a traditional in-person course; I believe a complete course can be given online without difficulty; I could pass a course online without any teacher assistance	• 6 items (of 7) • 5-point Likert scale • *Strongly disagree* = 0 to *strongly agree* = 5; collapsed to *strongly disagree*/*disagree* = 1; *neutral* = 2; *agree*/*strongly agree* = 3 • 0 reverse coded
	Student's self- reported belief about their initiative and ability to be self- directed	When it comes to learning and studying I am a self-directed, take charge kind of person; In my studies I am self-disciplined and find it easy to set aside reading and homework time I am able to manage my study time effectively and easily complete assignments on time; In my studies, I set goals and have	• 4 items used (of 15) • 5-point Likert scale • *Strongly disagree* to *strongly agree* • 0 reverse coded

Engagement	Self-reported engagement with academic challenges, active/collaborative activities, and course community	I was captivated; I felt wrapped up in the experience; I was absorbed in the experience; I was attracted to the learning activities; The class was an enriching experience; Class was fun and exciting; The class kept me totally absorbed in the activity; The class held my attention; The class excited my curiosity; The class aroused my imagination	• 10 items used (of 21) • 5-point Likert scale • *Strongly disagree* to *strongly agree* • None reverse coded
Learning	Student's self- reported perceptions of learning	The class allowed me to better understand concepts; The class helped me understand the course material; The class made it easy to connect ideas together; The class helped me think more deeply about course material; The class did not help my learning; The class did not make it easier for me to understand the course material; I was not able to better understand course concepts	• 6 items used (of 10) • 5-point Likert scale • *Strongly disagree* to *strongly agree* • Some reverse coded
Performance	Student's self- reported perceptions of performance on assessments and overall in course	The class activities helped me get a better grade; My experience in the course helped me do better on my exams and other assignments; The class activities did not help me score higher on the exams; I got higher scores on my assignments because of my experience in the course; The class activities did not improve my assignment grades	• 5 items • 5-point Likert scale • *Strongly disagree* to *strongly agree* • Some reverse coded
Beliefs	Student's self- reported belief of their grade earned	What final grade do you expect to receive in this class?	1 = A; 2 = A-/B+; 3 = B; 4 = B-/C+; 5 = C; 6 = C-/D =; 7 = D; 8 = D-/F+; 9 = F 99 = Don't know

Video engage	Treatment student response	Describe if and how the learning activity (class video presentation) changed your engagement.	Open-ended question
Video learn	Treatment student response	Describe if and how the learning activity (class video presentation) changed your learning experience.	Open-ended question
Final exam score	Total points on final exam	Instructor data	Numeric continuous on scale of 100 or 150 points per class
Multiple-choice questions	Total correct multiple-choice questions in class	Instructor data	Numeric continuous on a scale of 48–50 per class
Posttest questions correct	Total correct answers on selected 10 pre- and posttest questions	Instructor data	Numeric continuous on a 0–10 scale
Value-added difference pre- and posttest questions	Difference between number of correct questions when same questions done in pretest and in posttest	Instructor data	Numeric continuous on a scale of -10 to 10

Appendix C: Significance and Interaction of Treatment and Subgroup Characteristics on Value-Added Scores From Pretest and (Final) Posttest Questions

Variable/group	Type III SOS	Degrees of freedom	*F*-statistic	*p*-value
Low incoming GPA				
Treatment	19.09	1	11.09	.19
Low GPA	13.48	1	7.83	.22
Interaction	1.72	1	0.26	.61
Gender				
Treatment	18.45	1	29.90	.12
Gender	0.72	1	1.17	.48
Interaction	0.62	1	0.09	.77
Hispanic				
Treatment	11.07	1	2.85	.34
Hispanic	7.63	1	1.97	.40
Interaction	3.88	1	0.57	.45
Pell Grant eligible (PGE)				
Treatment	8.24	1	16.13	.16
PGE	0.39	1	0.77	.54
Interaction	0.51	1	0.07	.79
Mother's education				
Treatment	3.24	1	0.70	.41
Mother's education	49.92	2	9.73	.09
Interaction	5.13	2	0.39	.68
Native English speaker				
Treatment	7.81	1	905.46	.02
English	12.63	1	1464.80	.02
Interaction	0.01	1	0.001	.97