Paper Title Does Online Course-Taking Increase Distal Student Success? Examining Impacts on College Graduation Rates and Time to Degree

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Objectives

Success in postsecondary education is often viewed as a key determinant for both individual career trajectories and for continued prosperity and societal well-being (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2007). In the United States, however, recent statistics from National Center for Education Statistics indicate that only about 60% of first-time, full-time students at 4-year institutions successfully graduate college within six years (Kena et al., 2016). Also, roughly 20% of college students who enroll in 4-year institutions do not return for further studies the following fall term (Kena et al., 2016). Prior research suggests that most of the dropouts happen in the earlier years of college when students are mainly completing required courses (e.g., Ishitani, 2006; Lesik, 2007). Potential reason for these high dropout rates include that students might be unable to enroll in required courses or re-take required courses on time due to high student demand or scheduling constraints.

Online courses, an increasingly important part of students' college experience in the United States, are one promising option for broadening participation and increasing success. In 2014, more than a quarter of all undergraduate students participated in online coursework (Snyder, de Brey, & Dillow, 2016). Advocates of distance education assert that online courses provide greater and easier access to coursework for students while also serving as cost-effective forms of instruction for universities (e.g., Bartley & Golek, 2004; Waschull, 2001; Watson & Gemin, 2008). However, numerous research studies indicated that student learning and performance on near college success factors (e.g., course completion, course grades, success in

subsequent courses) is slightly lower in online settings compared to traditional face-to-face environments (e.g., Bettinger, Fox, Loeb, & Taylor, 2017; Figlio, Rush, & Yin, 2013; Xu & Jaggars, 2013, 2014). Interestingly, while online learning provides promising opportunities to reduce delay in the fulfillment of course requirements and thus to increase graduation rates, research studies that examine the impact of online courses on more distal college success factors (e.g., time-to-degree, graduation rates) are currently lacking in the literature base. Consequently, this study attempts to fill this gap in the literature by examining the following research questions:

Research question 1: What are associations between enrollment in online lecture courses and students' 4-year, 5-year, and 6-year graduation rates?

Research question 2: What are associations between enrollment in online lecture courses and students' time-to-degree for students who graduated?

Theoretical Framework

In the changing higher education landscape, online courses are increasingly gaining popularity with students and administrators and transforming students' college experiences. However, online courses also pose challenges to students. Most importantly, online learning depends upon students having greater agency to self-direct learning processes which requires higher self-discipline and self-regulation skills (Broadbent & Poon, 2015; Cho, Kim, & Choi, 2017; Firmin et al., 2014; Kizilcec, Pérez-Sanagustín, & Maldonado, 2017; Parkes, Stein, & Reading, 2015; You, 2016). Although such self-regulation skills are also important in face-to-face environments, fixed course schedules and physically-present teachers make these skills less important in traditional settings (Bork & Rucks-Ahidiana, 2013). Furthermore, students may feel more isolated from their peers as effective interpersonal interactions are more difficult to implement in online settings (Bernard et al., 2009; Jaggars & Xu, 2016; Kuo, Walker, Schroder,

& Belland, 2014). The influence of these challenges is mirrored in research studies that indicated that students tend to perform lower in online courses compared to corresponding face-to-face courses (e.g., Bettinger et al., 2017; Figlio et al., 2013; Xu & Jaggars, 2011, 2013, 2014).

Despite students demonstrating greater short-term success in traditional face-to-face environments, online courses provide alternative learning opportunities, which may serve as a lever to help students to successfully graduate college. In contrast to face-to-face environments, online courses allow students more flexibility in when and where to enroll in coursework (Waschull, 2001; Watson & Gemin, 2008). This scheduling flexibility and increased access might foster students' efficiency in their course-taking and positively affect more distal college success outcomes such as time-to-degree and college graduation rates. For instance, flexible scheduling of online courses assists in meeting students' individual needs to avoid scheduling conflicts with face-to-face classes, part-time jobs and internships, and other out-of-class commitments (Daymont, Blau, & Campbell, 2011; Hirschheim, 2005). Without the availability of online course offerings, students may not be able to enroll in corresponding face-to-face courses, thus, reducing their ability to progress towards degree completion. Another example of increased access is that online courses may provide opportunities for students to enroll in courses that may otherwise not be offered due to course over-enrollment or departmental scheduling constraints (Gould, 2003; Lei & Gupta, 2010). For instance, departments frequently offer introductory high-volume lecture courses in online settings to counteract resource constraints with respect to faculty and physical spaces (Twigg, 2003). Also, departments might offer off-sequence online courses of required introductory courses to allow students who did not pass the in-sequence course an opportunity to stay on-track for timely graduation (Watson & Gemin,

2008). Consequently, this study examines associations of online course-taking on more distal college student success factors.

Methods and Data Sources

This quantitative study is situated at a selective public research university in Southern California as part of a large multi-year National Science Foundation-funded research project. This study utilized six years of institutional data for three cohorts of newly matriculated freshman students in fall terms of 2009, 2010, and 2011 (N = 13,556 students). Institutional data was provided from the Registrar's Office, the Office of Institutional Research, Admission, and Summer Session.

The *dependent variables* for the first research question are dichotomous variables indicating whether students graduated within four, five, or six years of their first college enrollment. For the second research question, the dependent variable describes students' time-to-degree which is measured by the number of terms a student enrolled in coursework until college graduation. Each academic year has four terms with three terms mandatory for full time enrollment (fall, winter, and spring quarters) and one term of optional coursework (summer quarter). The *independent variable* of this study describes student enrollment in online courses as measured by the number of online lecture courses a student enrolled in throughout the student's college career. Notably, this variable only includes four-unit lecture courses. Four-unit lecture courses represent the most common online courses offered at this university, which corresponds to previous research that indicates preferences of departments to offer large, introductory courses in online course modalities (Twigg, 2003). These restrictions attempt to make the number of online course attendances more equal across students as, for instance, a one unit online seminar offers arguably less online learning affordances compared to an introductory four unit chemistry

lecture course. *Covariates* include student demographics (i.e., gender, racial/ethnic background, in-state residency), student background characteristics (i.e., first-generation college student status, low-income student status, English language learner status), and college history characteristics (i.e., college admission score [which is based on SAT/ACT scores], number of passed Advanced Placement exams, number of summer term enrollments). Table 1 illustrates descriptive information for all dependent and independent variables of the full student sample. Missing data is below 5% across all variables. Markov-chain Monte Carlo multiple imputation methods with 150 iterations and 100 imputations were applied to address the missingness in the independent variables prior to the statistical analyses and separately for each research question (Cheema, 2014; Graham, 2009).

[Table 1 about here]

The *first research question* utilized the entire student sample (N = 13,556) and applied logistic regression models with robust standard errors to examine associations of the number of online courses towards student graduation rates (Harrell, 2015). To aid the interpretation of the results, average marginal effects in terms of predicted probabilities were computed. The *second research question* utilized the sample of all students who successfully graduated within 6 years (N = 11,966) and applied ordinal least square regression models with robust standard errors to estimate the impact of the number of online courses on students' time-to-degree (Montgomery, Peck, & Vining, 2012). The full paper will expand this analysis by leveraging the phased rollout of online courses to estimate causal effects of departments offering online courses for students in the 15 most common majors utilizing fixed effects regression models (Allison, 2009). Cohort fixed effects and major fixed effects control for characteristics that are constant within cohorts and majors, respectively, even if these characteristics are unobserved to remove omitted variable

bias. Additionally, subgroup analyses will examine differences for students traditionally at-risk in college environments (e.g., first-generation college students, low-income students, underrepresented minority students).

Results

Examining associations with college graduation rates

Logistic regression analyses indicate that online course enrollments were significantly associated with higher student graduation rates, controlling for a range of student demographic, student background, and college history characteristics (Table 2). Regarding 4-year graduation rates, each online course participation is significantly associated with higher log odds of successful graduation by a factor of 0.074, β=0.074, t=3.16, p<0.01. This association represents an on average 1.34% higher predicted probability of successful graduation within four years for each online course participation. Regarding 5-year graduation rates, each online course participation is significantly associated with higher log odds of successful graduation by a factor of 0.253, β=0.253, t=5.56, p<0.001. This association represents an on average 2.51% higher predicted probability of successful graduation within five years for each online course participation. Regarding 6-year graduation rates, each online course participation is significantly associated with higher log odds of successful graduation by a factor of 0.432, β=0.432, t=7.51, p<0.001. This association represents an on average 3.76% higher predicted probability of successful graduation within six years for each online course participation.

[Table 2 about here]

Examining associations with time-to-degree

Linear regression analysis indicates that the number of online course enrollments is significantly associated with shorter time to graduation (Table 3). However, this effect is small. Each online course participation is associated with a 0.067 decrease in students' terms to graduation, b=-0.067, t=-4.98, p<0.001.

[Table 3 about here]

Scholarly Significance

This large-scale quantitative study contributes to the higher education research base by examining distal student success factors of online course-taking at a selective public research university. This extends the current research base on online course enrollments in higher education settings which primarily examined near college student success factors (e.g., course completion, course performance, subsequent course success) situated at community colleges or for-profit universities (e.g., Bettinger et al., 2017; Kaupp, 2012; Xu & Jaggars, 2013, 2014). Also, it constitutes one of few studies that uses large-scale institutional data to comprehensively examine the impact of online course enrollments on student success factors by longitudinally tracking three full cohorts of entering college freshman across all student majors for six years. Thus, this study has sizable statistical power and potential to generalize inferences for larger college student populations across the country. This study intends to inform and guide educational policy makers and higher education administrators considering to expand their online course offerings.

The most important finding of this study is the following: Online course-taking is associated with higher college graduation rates. Notably, this effect is strongest for 6-year graduation rates, followed by 5-year and 4-year graduation rates. Also, online course-taking is

associated with slightly shorter time-to-degree for students successfully graduating college. This is a promising finding that speaks to the potential of online courses to align student trajectories towards success in higher education. Despite somewhat lower student performance in online courses compared to their corresponding face-to-face courses (e.g., Bettinger et al., 2017; Figlio et al., 2013; Kaupp, 2012; Xu & Jaggars, 2013, 2014), online course enrollments may provide distal benefits to increase the potential for students to graduate college. Efforts to improve existing online courses, for instance, by providing students with more opportunities to improve their self-regulation skills (e.g., Broadbent & Poon, 2015; Cho et al., 2017; You, 2016), are laudable. However, departments should recognize that online courses may bring distal benefits even if student performance lags slightly in them, and may wish to consider adding further online courses to increase the likelihood of students successfully completing course requirements and graduating.

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Tables

Table 1. Descriptive information of the full student sample.

	Mean / N [Percentage]	Standard deviation
Dependent variables		
Graduated in 4 years	73.26 %	
Graduated in 5 years	86.98 %	
Graduated in 6 years	88.27 %	
Terms to degree	12.91	3.42
Independent variable		
Number of online lecture courses		
0	61.72 %	
1	23.30 %	
2	9.20 %	
3	3.54 %	
4	1.30 %	
5	0.47 %	
6	0.21 %	
7	0.15 %	
8	0.07 %	
9	0.03 %	
10	0.01 %	
11	0.00 %	
12	0.01 %	
Covariates		
Number of summer terms	1.71	1.26
Female (vs. male)	56.96%	
Students' racial or ethnic background		
White	18.45%	
Black or African American	2.54%	
Hispanic or Latino	19.90%	
Asian or Asian American	58.52%	
Native American or Pacific Islander	0.59%	
English language learner	25.14%	
In-state resident	94.68%	
Low-income student	29.07%	
First generation college student	37.85%	
College admission score	194.67	36.61
Number of passed AP exams	3.11	2.69

Notes. N = 13,556, AP = Advanced Placement.

Table 2. Logistic regression analysis with robust standard errors examining associations to college graduation rates.

	4-year graduation rate					5-year graduation rate					6-year graduation rate				
	Log odds	S.E.	Marginal effect	S.E.	*t*	Log odds	S.E.	Marginal effect	S.E.	*t*	Log odds	S.E.	Marginal effect	S.E.	*t*
Intercept	-1.135***	0.176			-6.44	-1.772***	0.227			-7.82	-2.068***	0.242			-8.53
Number of online courses	0.074**	0.023	1.34%	0.42%	3.16	0.253***	0.046	2.51%	0.44%	5.56	0.432***	0.057	3.76%	0.49%	7.51
Number of summer terms	0.086***	0.019	1.56%	0.34%	4.56	0.660***	0.031	6.54%	0.29%	21.02	0.842***	0.034	7.34%	0.27%	24.6
Female (vs. male)	0.722***	0.041	13.18%	0.72%	17.65	0.565***	0.054	5.60%	0.54%	10.38	0.531***	0.058	4.63%	0.51%	9.15
Race/Ethnicity (vs. White)															
Black	-0.093	0.129	-1.70%	2.35%	-0.72	-0.373*	0.161	-3.69%	1.59%	-2.32	-0.407*	0.172	-3.55%	1.50%	-2.37
Hispanic	-0.274***	0.069	-4.99%	1.26%	-3.97	-0.249**	0.090	-2.47%	0.90%	-2.76	-0.221*	0.095	-1.92%	0.83%	-2.32
Asian	0.259***	0.057	4.73%	1.04%	4.56	0.035	0.076	0.35%	0.75%	0.47	0.009	0.080	0.08%	0.70%	0.11
Native	-0.131	0.269	-2.38%	4.91%	-0.49	-0.121	0.364	-1.20%	3.60%	-0.33	0.158	0.398	1.38%	3.46%	0.40
English language learner	-0.096	0.049	-1.74%	0.90%	-1.94	-0.075	0.066	-0.74%	0.66%	-1.13	-0.091	0.071	-0.79%	0.62%	-1.28
In-State resident	0.421***	0.087	7.67%	1.59%	4.81	0.765***	0.105	7.59%	1.03%	7.32	0.740***	0.112	6.45%	0.97%	6.63
Low-income	-0.338***	0.050	-6.17%	0.91%	-6.74	-0.201**	0.068	-1.99%	0.67%	-2.96	-0.189**	0.072	-1.65%	0.63%	-2.63
First generation	0.182***	0.049	3.33%	0.89%	3.75	0.169**	0.064	1.68%	0.64%	2.63	0.133	0.068	1.16%	0.59%	1.95
Admission score	0.005***	0.001	0.09%	0.01%	6.02	0.007***	0.001	0.07%	0.01%	6.88	0.009***	0.001	0.07%	0.01%	7.75
Number of AP exams (passed)	0.088***	0.010	1.60%	0.18%	8.57	0.132***	0.015	1.31%	0.15%	8.77	0.129***	0.016	1.13%	0.14%	8.00

Notes. ***p < 0.001, **p < 0.01, *p < 0.05; marginal effects columns represent average marginal effects in terms of predicted probabilities; S.E. = Standard error; AP = Advanced Placement; *N* = 13,556.

Table 3. Ordinal least squares linear regression analysis with robust standard errors predicting students number of terms until graduation.

	Coefficient	Standard Error	*t*	*p*
Intercept	11.706	0.118	99.21	< 0.001
Number of online courses	-0.067	0.013	-4.98	< 0.001
Number of summer terms	1.154	0.011	107.21	< 0.001
Female (vs. male)	-0.369	0.025	-14.92	< 0.001
Race/Ethnicity (vs. White)				
Black	0.102	0.085	1.20	0.231
Hispanic	0.235	0.046	5.08	< 0.001
Asian	-0.017	0.035	-0.48	0.634
Native	0.107	0.172	0.62	0.533
English language learner	0.019	0.030	0.65	0.514
In-State resident	0.474	0.069	6.86	< 0.001
Low-income	0.272	0.030	9.00	< 0.001
First generation	0.007	0.028	0.26	0.794
Admission score	-0.001	0.000	-2.23	0.026
Number of passed AP exams	-0.030	0.006	-5.25	< 0.001
N	11,966			
R^2	0.550			

Notes. AP = Advanced Placement.