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Project Description I

Title:

Does Course Delivery Format Matter? Evaluating the Impacts of Online Learning on Student Success in a State Community College System

Statement of the research problem and national importance:

One of the most pronounced trends in higher education over the last decade has been a fast growth of distance education through online coursework. More than 20% of higher education students took at least one online course during the fall 2008 term, a 17 percent increase over the number reported the previous year, which far exceeds the 1.2 percent growth of the overall higher education student population (Allen & Seaman, 2010). Advocates of distance education have noted several potential benefits of online learning in comparison to the traditional face-to-face format. Online courses offer the flexibility of off-site asynchronous education (Peterson & Bond, 2004) and have the potential to provide strong computer-mediated student-to-student interaction and collaboration (Cavus & Ibrahim, 2007; Harasim, 1987), as well as immediate feedback on student learning (Brown, Lovett, Bajzek, & Burnette, 2006). Advocates are also particularly optimistic about the potential of fully online coursework to improve and expand learning opportunities at community colleges, where a large proportion of students hold part- or full-time jobs (Kleinman & Entin, 2002). These potential advantages make online courses particularly attractive in the community college setting, and indeed, online learning enrollments have increased more quickly at two-year colleges than at four-year colleges in the past decade (Choy, 2002; Parsad & Lewis, 2008).

Despite the rapid growth of and high hopes for distance education in community colleges, questions remain regarding its effectiveness in this particular educational setting. Although the “no significant difference” phenomenon between face-to-face and distance education described by Russell (2001) continues to dominate the literature, the majority of studies in this area focus on students who are well-prepared and motivated to succeed in the course. As a result, we have little evidence on the effectiveness of online courses among the low-income and academically underprepared students who make up the bulk of community college students. However, some existing studies on a particular course or (e.g., Bendickson, 2004; Chamber, 2002; Vargo, 2002) on individual institutions (e.g., Carpenter, Brown, & Hickman, 2004; Zavarella, 2008) suggest that online courses are often associated with less desirable course outcomes for underprepared students. Given the rapid growth of online courses in community colleges, it is important to verify that these courses do no harm to students’ academic success in this particular educational setting.

The proposed research attempts to take a step toward filling this void by estimating the impact of course delivery format on course outcomes within an entire state community college System. Considering that student may sort among course formats in nonrandom ways, I will employ an instrumental variable strategy (IV) approach using the distance from a student’s home to college as an instrument for the student’s likelihood of enrolling in an online section rather than face-to-face. The IV strategy will be further augmented by course fixed effects, which will enable me to compare students who took the same course but were enrolled in different sections with different delivery formats, potentially controlling for biases related to both within- and between-course selection. In addition to the general impacts of online course delivery format, there is also an increasing national interest in understanding how such impacts might vary among different types of students and among different course subjects. Therefore, my research proposal will further explore whether the impact of online format varies systematically with students’ characteristics and with course subjects.

In addition to addressing selection problem, the proposed study contributes to the online literature in several important ways. First, unlike most previous studies, it focuses exclusively on community colleges, where the bulk of students are academically under-prepared. Second, it sets out as the first study to explore heterogeneity among different course subjects and different types of students. If there do exist heterogeneous effects, the results could have important implications not only for individual students in their course format selection, but also for policy makers in their search for ways to facilitate students’ progression through postsecondary education. Finally, findings from this study also have important implications for the IPEDS data collection efforts. At present, there is no national source of information on online learning effectiveness in

post-secondary institutions. If this study were to find solid evidence on the effects of course delivery format, it would provide a strong case for the collection of data on online course offering and its success. Moreover, to the extent that the impact of online delivery format is found to be heterogeneous, this study would provide guidance as to the relevant online effectiveness factors that warrant further exploration nationwide.

Review the literature and establish a theoretical grounding for the research:

Online course enrollments have grown rapidly at public two-year institutions during the last decade. In 1997–98, public two- and four-year institutions each had approximately 710,000 enrollments in distance education courses (Choy, 2002). In 2006–07, distance enrollments at public two-year institutions rose to nearly 5 million, approximately twice as many enrollments as there were in distance education at public four-year institutions (Parsad & Lewis, 2008). By 2007, over 97% of two-year colleges, versus 66% overall in all postsecondary institutions, offered online education courses (Parsad & Lewis, 2008).

The most commonly cited reason for the importance of online learning is student access (Allen & Seaman, 2008; Beatty-Guenter, 2002; Parsad & Lewis, 2008). According to a recent report on distance education at degree-granting postsecondary institutions (Parsad & Lewis, 2008), 92% of the institutions cited “meeting student demand for flexible schedules” (p. 16) as affecting distance education decisions to a moderate or major extent. Other important factors with moderate or major effects on distance education decisions include “providing access to college for students who would otherwise not have access” (89%), “making more courses available” (86%), and “seeking to increase student enrollment” (82%). Students also tend to endorse convenience and flexibility as primary reasons for taking online courses (e.g., Block, Udermann, Felix, Reineke, & Murray, 2008). Studies that describe the demographic characteristics of online students (Cohen & Brawer, 2003; Imel, 1998; Perez & Foshay, 2002) generally agree that students participating in distance education are more likely to be nontraditional³ students, who may find it difficult to attend on-campus courses due to employment or family commitments. The potential advantages of distance learning among the non-traditional population have thus encouraged online courses to flourish in community colleges, where 90% of the students are defined as nontraditional, compared to 58% in four-year public universities (Choy, 2002).

A large body of non-experimental studies have compared learning outcomes in online and face-to-face courses among students who complete a given course. There is wide variation in the pattern of results across studies, with some finding positive results for online learning and others finding negative results (Jahng, Krug, & Zhang, 2007; Phipps & Merisotis, 1999; Sitzmann, Kraiger, Stewart, & Wisher, 2006; Zhao, Lei, Yan, Lai, & Tan, 2005). In an attempt to combine the results of the highest-quality individual studies, the U.S. Department of Education (2009) recently conducted a meta-analysis that considered only random-assignment or quasi-experimental studies. The meta-analysis concluded that fully online and hybrid-online courses had, on average, equal or better learning outcomes than face-to-face courses. However, only seven of the studies in the meta-analysis were relevant to typical online semester-length college courses (Caldwell, 2006; Cavus & Ibrahim, 2007; Davis, Odell, Abbitt, & Amos, 1999; LaRose, Gregg, & Eastin, 1998; Mentzer, Cryan, & Teclehaimanot, 2007; Peterson & Bond, 2004; Schoenfeld-Tacher, McConnell, & Graham, 2001). Overall, these seven studies showed no strong advantage or disadvantage in terms of learning outcomes⁴ among students who stayed in the course throughout the entire semester. However, all seven studies involved relatively well-prepared students attending mid-sized or large universities, five of which were rated as “selective” or “highly selective” by U.S. News and World Report. Only one of the studies (Peterson & Bond, 2004) examined the impacts of the course method on lower-performing students; its results suggested that the bottom one-third of students performed better in the face-to-face setting than in the online setting. A recent experimental study comparing learning outcomes between online and face-to-face sections of an economics course (Figlio, Rush, & Yin, 2010) found no significant difference between the two groups overall but noted that among students with low prior GPAs, those in the online condition scored significantly lower on in-class exams than did those in the face-to-face sections. These findings have led some researchers to suspect that online instruction might not be as effective as face-to-face instruction for academically underprepared students.

In addition, the bulk of research comparing online and face-to-face courses has focused on learning outcomes among those who complete the course, paying little attention to potential differentials in the rate of course completion. Two regression studies that controlled for multiple covariates have focused on online versus face-to-face course withdrawal in the community college context. First, in a study of a developmental writing course in a community college (Carpenter, Brown, & Hickman, 2004), students in the online version of the course were substantially more likely to withdraw over the course of the semester than were students in the face-to-face version (after controlling for initial reading and writing placement scores, gender, minority status, full-time student status, late versus early registration for the semester, and age). It may not be surprising, then, that online students who stayed in the course were more likely to earn a good grade than were face-to-face students who stayed. Second, a study of developmental mathematics students in community college found that completion rates were higher for face-to-face (80%) than online (61%) courses, a difference which remained consistent and was statistically significant after controlling for age, ethnicity, marital status, gender, and social-interaction learning style (Zavarella, 2008). In the Zavarella study, approximately half of the students who withdrew provided the reason for their withdrawal: 70% of online student respondents withdrew because of technical problems, computer-based learning issues, or other factors related to the online nature of the course. Although the Carpenter et al. (2004) and Zavarella (2008) studies used regression techniques to control for observable differences, they could not rule out the possibility that some unobserved student characteristics, such as motivation might correlate with both online course enrollment and course outcomes. If that were the case, the OLS estimates would be biased. In addition, both of the two studies, together with

most existing research in this field are based on relatively small sample sizes of students taking a particular course in a single institution, which limits the external validity of the research findings. Moreover, none of the existing studies have explored possible heterogeneous effects of online course format on different types of students and in different subject areas. There is wide variation in the pattern of results across existing studies on the impact of course delivery format on course outcomes and some potential causes of such variation might be individual characteristics or the nature of different course subjects. For example, academically more committed and motivated students might have more perseverance in dealing with problems, such as technical difficulties and sense of isolation that might pop up when taking online courses, and may therefore be less susceptible to the negative impact of online format. As for different subject areas, the relative effectiveness of alternative course format may differ by subjects depending on the degree to which a discipline values teacher-student interaction and the extent to which the interactions can be achieved through cyber space. For instance, fields within applied professional subjects may require a high degree of instructors' demonstration, instructor-student interaction, and immediate feedback, which can be hardly substituted by online demonstration. In contrast, the applied science fields such as engineering might require less interaction in the learning process and such interaction can also be achieved much more easily through internet.

Overall, the evidence on online versus face-to-face learning outcomes among community college students is scant. Questions about the causal effect of online course delivery format, how the effect varies with students' characteristics, or with different course subjects, remain largely unknown. The goal of this proposal is to fill this knowledge gap among policy makers by overcoming some of the methodological shortcomings in the previous literature.

Describe the research method that will be used:

To achieve a good understanding of online course enrollment and success in community colleges, the proposed study will address five major research questions:

1) How do online course enrollments differ across different colleges, subject areas and terms?

This first research question intends to provide a general sketch of online enrollments in the Washington Community College System. Specifically, I am interested in exploring whether there exist apparent variations in online course enrollment rates across the 34 community colleges. If there do exist apparent variations, what institutional characteristics are significantly associated with online course enrollments? Do online enrollments grow fast across the five-year period of study between 2004 and 2009? Are there substantial variations of online enrollments across different subject areas? If so, in what subject areas are online course formats currently more popular? The analysis for this research question will start with basic descriptive statistics and further use regression to identify institutional characteristics that have significant association with online enrollments. The college-level variables will be retrieved from the IPEDS 2004 data.

2) What are the demographic and academic characteristics of students who have ever attempted an online course during the five-year period of study? How do those characteristics differ from students who only took traditional face-to-face format?

The goal of this research question is two-fold: on one hand, it intends to identify the targeted population of online courses for policy makers; on the other hand, it attempts to identify student-level attributes that are associated with course format selection. One of the major advantages of the Washington data set is that it includes rich information about student characteristics, such as academic attributes, working hours in each term and neighborhood characteristics, which are often absent from existing studies that evaluate online course success. In a similar vein, the analysis for this research question will also start with basic descriptive statistics and then use regression to identify student-level variables that are significantly related to online course enrollment.

3) What is the impact of online course format on course retention? Among those who persisted through the course, what is the impact of online course format on course grade?

3.1) Basic Empirical Model

This is the key research question in this proposed study. To assess the effects of course delivery format, I will use regression techniques, beginning with a basic OLS model. The key explanatory variable is whether or not students took a course through the online format or face-to-face format. The basic strategy relates student i 's course outcomes in subject k at campus j in term t to the course format:

$$Y_{ikjt} = \alpha + \beta \text{online}_{ikjt} + \gamma X_i + \pi_t + \rho_k + \sigma_j + \mu_{ikjt} \quad (1)$$

Where online is the key explanatory variable and is equal to 1 if the course is offered through online; X_i includes demographic attributes (e.g. age, gender, race, SES), academic indicator (e.g. remedial status, dual enrollment), and semester-level information (e.g. working hours in this term, total credits taken in this term). In addition, I will also include fixed effects for the term of enrollment in the course (π_t), the subject of the course (ρ_k), and the campus of attendance (σ_j).

3.2) Addressing Between-course Selection Using Fixed Effects Approach

The proposed analysis intends to relate students' course outcomes to the course delivery formats they choose. However, the distribution of delivery formats across courses may not be random. First, students may choose different courses based on their preferences for particular types of course formats. Additionally, online courses may also be more likely to be offered in particular colleges, terms, departments or courses, and as a result certain types of students will be more likely to attend online courses than others. Although I have partly addressed this issue by including college, term, and subject fixed effects, the basic empirical model (equation 1) would be subject to bias if certain courses, even within a particular college, term, and subject are more likely to offer online sections than others. For example, suppose that advanced-level courses are more likely to offer online formats than entry-level courses within a department. Directly comparisons between these different courses would get biased results due to different student compositions in online courses and face-to-face courses. I will address the issue of format selection across courses using course fixed effects model that compare students who took the same course but were assigned into different sections with different course delivery formats. This strategy can effectively control for unobserved heterogeneity related to the fact that the likelihood of enrolling in an online course may be related to student characteristics such as major and academic attributes through selection across courses.

3.3) Address Within-course Selection Using Instrumental Variable Approach

Although course fixed effects are an effective means of controlling for student sorting across courses, there may be some remaining selection issues if students systematically sort between online and face-to-face sections within a single course. If the unobserved student characteristics are correlated with both within-course selection and course outcomes, the estimates based on course fixed effects model would also be biased. To deal with the remaining concerns about within-course selection, I will employ an instrumental variable strategy (IV) approach using the distance from a student's home to college as an instrument for the student's likelihood of enrolling in an online section rather than face-to-face. Given that online courses offer the flexibility of off-site education, students who live comparatively further away from colleges might be more likely to take advantages of online courses compared to students living closer to colleges. Preliminary analyses on the data indicate that the distance between students' home to colleges is an important and significant predictor of online enrollment propensity. This supports using distance as an IV for the two stage least square estimate:

$$Y_{ikjt} = \alpha + \beta' \text{online}_{ikjt} + \gamma X_i + \pi_t + \rho_k + \sigma_j + \mu_{ikjt}$$

$$\text{where: Online}_{ikjt} = \alpha + \delta \text{distance}_i + \gamma X_i + \pi_t + \rho_k + \sigma_j + \mu_{ikjt} \quad (4)$$

The difference between the IV approach and straightforward OLS estimate is that the key explanatory variable online_{ikjt} is instrumented for in the second part of equation (4) with the distance from the students' home to the college of attendance. The coefficient β' thus represents an unbiased estimate of the impact of course format on course outcomes based on the assumption that distance to college can only influence course outcomes through its impact on online course enrollment.

There are two main assumptions underlying IV strategy: i) the instrument must be correlated with the endogenous explanatory variables, and ii) the instrument can only influence the outcome variable through its impact on the endogenous explanatory variable (Angrist & Krueger, 2001). As such, the other major concern about using distance as an instrument is that distance might directly affect student course outcomes and therefore be endogenous. I address this concern by examining the relationship between course outcomes and distance for a subsample of students who never enrolled in any online course. Because these individuals were not influenced by course delivery format, they form a natural control group to test whether distance affects course outcomes for reasons other than online enrollment. If distance affects course outcomes for a reason other than online enrollment, I would expect distance to be related to course outcomes for this subsample. On the other hand, if distance only affects course outcomes through its impacts on online enrollment, I would not expect any relationship in this subsample. Preliminary results of this exploration suggest that there is no relationship between course outcomes and distance for these students. This finding, together with the significant relationship between distance and online enrollment indicates that the IV estimate of the effects of online format reflects the effects of the course delivery format.

4) Does the impact of course delivery format vary by gender, age, ethnicity, academic preparation, or course subject areas?

This last research question intends to explore possible heterogeneity of the online format impacts among different types of

students and across different course subjects. For this research question, separate regression analysis will be conducted for each subsample. Taking gender as an example, two separate regressions will be conducted for males and for females.

Uploaded Appendix Document(s):

- [Table 1 & Table 2](#)

Project Description II

Will you use NCES target dataset? Yes

Please check all NCES datasets that apply
- IPEDS Institutional Characteristics (IC)

Explain why each dataset best serves this research. Include a variable list for each dataset used.

The IPEDS Institutional Characteristics data sets serve two purposes:

- 1) It allows me to explore institutional characteristics that are significantly associated with online course enrollments.
- 2) It allows me to compare the mean institutional characteristics of the 34 community colleges in Washington State with the national average. If there are no substantial differences, the results of the proposed study may be reasonably considered to reflect on distance education issues facing many other community colleges nationwide.

Variable list:

collid
pctminority
pctfedaaid
urban
rural
suburb
instexp
acaexp
stuexp
intexp;

Will you use NSF target dataset? No

Explain why each dataset best serves this research. Include a variable list for each dataset used.

Will you address the NPEC focus topic? Yes

If yes, please briefly describe:

This proposal directly addresses this year's NPEC focus topic by nominating course retention as an important measure of institutional effectiveness and student success.

Project Description III

Provide a timeline of key project activities:

The work plan for the academic year under the AIR grant starts in May 1, 2010 and culminates in April 30, 2012. This time

period will provide me with adequate time to complete the proposed study given that I have already received all the necessary data from the Washington State Board of Community and Technical Colleges. I have also finished cleaning and formatting the data for the analysis. The timeline of key project activities are listed as follows:

Summer 2011: In-depth literature review; descriptive statistics;

Fall 2011: data analysis; presenting preliminary results in the economics and education seminar at Teachers College; oral defense of research proposal; submitting the research proposal for the 2012 AIR annual forum

Spring 2012: finishing data analysis; writing dissertation draft; sharing main results with the Washington State Board of Community and Technical Colleges; presenting research findings at the AIR annual forum

May: submitting the final paper to AIR

List deliverables such as research reports, books, and presentations that will be developed from this research initiative:

I will prepare a final paper for AIR. I will also report the main results as a working paper to the Washington State Board of Community and Technical Colleges; the working paper will also be available at the website of the Community College Research Center at Teachers College. I also expect that my work on this topic will eventually lead to a submission of a research article for publication in a leading educational journal such as *Journal of Higher Education* or *Educational Evaluation and Policy Analysis*.

Describe how you will disseminate the results of this research:

Before the final paper is finalized, I will present my research work in the Economics and Education seminar at Teachers College and will disseminate my research findings with the Washington State Board of Community and Technical Colleges. In addition, the research paper will be publicly available through the Community College Research Center website. I will also take the opportunity to present my research at the AERA annual conference.

Provide a reference list of sources cited:

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IRB Statement

Statement of Institutional Review Board approval or exemption:

I have already received IRB approval for the proposed research from Teachers College and the Washington State Board of Community and Technical Colleges

Statement of Use of Restricted Datasets

The data sharing and agreement has already been completed and I have full access to the Washington data set.

Biographical Sketch

Di Xu is a Research Assistant at the Community College Research Center and is currently a doctoral student in Economics and Education at Teachers College, Columbia University. She received her Bachelor's in English Literature from Peking University, China and holds a Master's in Sociology and Education from Teachers College and a Master's in Applied Linguistics from the University of Cambridge in the UK. Her research interests include institutional effectiveness in community colleges and the use of quantitative research methods in evaluating the effects of governmental policies and projects on educational equity and efficiency.

Di is an advanced user of SAS, STATA and R and has extensive experiences working with large restricted-use datasets. This Dissertation topic is prompted by some earlier research findings (Xu & Jaggars, under review) based on data from a single course in another community college system. The strong negative impacts of online format observed from that course prompted the researcher into exploring the overall impact of online format, whether such impact is causal and the possibility of heterogeneity among different types of students as well as different types of courses using the unique data set from the Washington State. As a doctoral candidate in the program of Economics and Education at Teachers College, she has completed doctoral level courses in applied econometrics, missing data analysis, causal inference, labor economics, limited dependent variable analysis, and other advanced topics in quantitative methods. The quantitative skills obtained from these courses and the analytical experiences she has accumulated working with policy-related projects at Community College

Research Center have built a strong basis for her to successfully complete the proposed study.

Budget Requirements

Salary/Stipend: \$12034.00
Tuition and fees: \$7266.00
Travel: \$700.00
Other travel related expenses: \$0.00
Other research expenses: \$0.00
Total Request: \$20000.00

Funding History

I am recipient of Teachers College Scholarship during my doctoral study.
I have also received Sasakawa Young Leaders Fellowship Fund in the summer 2010.
I have not received funding for the proposed research and have not received funding from AIR in the past.

Letter of Support from Dissertation Faculty Advisor

- [Letter of Support](#)