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Online Learning in California Community Colleges

Technical Appendices

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Appendix A. Data and Methods

Data

The data used in this report come from the California Community College Chancellor’s Office Management Information System). Specifically, we use a longitudinal dataset of students enrolled in every college in the California Community College system. This dataset includes student demographics, course enrollment, and student outcomes. Additionally, the system has information on each course (title, credit status, transfer status, basic skills status, subject, etc.).¹ Table B4 lists the variables that we use in our analyses.

Most of our empirical strategy follows the work done by Xu and Jaggars (2013a, 2013b) at the Columbia University’s Community College Research Center. Our estimates for California community colleges are consistent with the evidence they found for Washington State’s Community College system.

Empirical Strategy for Estimating the Overall Effect of Online Learning on Student Course Success

To estimate the overall effect of online learning on course success, we restricted our sample to include only students who initially enrolled, as nonspecial-admit students, in one of California’s community colleges during the fall of 2006. We excluded students with invalid Social Security Numbers or with unknown birth dates. The reason for this exclusion is that these two data fields allowed us to identify students attending multiple campuses. We further restrict our sample to students between the ages of 15 and 64 at the time of first enrollment and students who remained in the CCC system for more than one term. We then tracked these students for over six years through the fall term of 2012. Because our goal is to understand the effect of course delivery format within specific courses, we exclude courses where all sections were offered through the same delivery method, that is, all courses in our sample were offered through both online and face-to-face sections. Finally, we focus on enrollment in credit courses only.

Student summary statistics are reported in Table B5. In addition to the statistics for the full 2006 student cohort (no restrictions), the table reports the statistics for the students in our sample of interest. Furthermore, it presents the characteristics of those students who took at least one course online during our period of analysis and of those who never did. Female students and white students are overrepresented among those students who ever enrolled in online sections. Interestingly but expected, 52 percent of the ever-online students attended more than one campus during their college career (versus 39% in the never-online sample) and lived slightly farther away from their main college of attendance. Descriptive information seems to show that better prepared students were more likely to enroll in online sections of a course at some point during their college career. Specifically, students ever enrolled in online sections were more likely to have been previously enrolled as special-admit students and to have shown “behavioral intent to transfer.” They were also more likely to take more units, remain longer in college, and have a higher GPA (Table B6). Yet, only 16 percent of the ever-online sample took more than 20 percent of their units online.

¹ The MIS was implemented in 1990 and seeks to collect data that can provide answers to fundamental questions related to students, courses, outcomes, student services, and faculty and staff. Colleges submit data to the Chancellor’s Office within 30 days of the end of each term.

We use regression techniques to estimate the effect of online delivery format on students' course success. Online is the key explanatory variable in our models and is equal to 1 if the course was taken in an online format.² Given the dichotomous nature of our dependent variable, we use probit models. The unit of observation is student enrollment in a given section of a course, in a given college, and for a given term. Our final sample for this analysis includes 757,544 section enrollments, of which 20.9 percent were in online sections.

We include a rich set of controls for student demographic characteristics and proxies for academic skill and preparedness. Specifically, we include dummy variables for college age, gender, race/ethnicity, nativity status, economically disadvantaged status, other financial aid recipient, highest level of education at the time of initial enrollment, prior dual enrollment, ever enrolled in basic skill courses, full-time status, disability status, academically disadvantaged status, intent to transfer, and enrolled in more than one college. We also include the students' GPA in their first term.

$$P(\text{Student success}_{ijtkm}) = \phi(\alpha + \beta \text{Online}_{ijtkm} + \delta_1 X_i + \delta_2 Z_{it} + \mu_{ijtkm}) \quad (1)$$

In the above equation, $\phi(\cdot)$ represents the cumulative density function for the standard normal distribution. Online_{ijtkm} is equal to 1 if the student took the course through an online section. X_i is a vector of time-invariant student attributes, and Z_{it} is a vector of term-specific student attributes.

To address the potential problem that online courses may be more prevalent within particular colleges, terms, and subject areas, we added fixed effects for term (τ_t), college of attendance (γ_j), and course subject area (θ_m) to equation (1).³

$$P(\text{Student success}_{ijtkm}) = \phi(\alpha + \beta \text{Online}_{ijtkm} + \delta_1 X_i + \delta_2 Z_{it} + \tau_t + \gamma_j + \theta_m + \mu_{ijtkm}) \quad (2)$$

The specification above does not control for the fact that certain courses may more likely be offered online. Therefore, to address concerns that the distribution of delivery formats across courses may not be random, we added course-by-college fixed effects (ρ_k) to equation (2).

$$P(\text{Student success}_{ijtkm}) = \phi(\alpha + \beta \text{Online}_{ijtkm} + \delta_1 X_i + \delta_2 Z_{it} + \tau_t + \rho_k + \mu_{ijtkm}) \quad (3)$$

Finally, to account for the possibility that additional unobserved characteristics (e.g., academic motivation and ability, time management, and self-directed learning skills) or characteristics for which we do not have information available (e.g., employment status and actual working hours) may jointly influence online course enrollment and student course success, we estimated an instrumental variable approach. Following Xu and Jaggars (2013a), we used the distance from the student's home to college of attendance as an instrument for the likelihood of enrolling in an online rather than face-to-face section of a given course. The assumption behind this instrument choice is that students do not choose where to live based on unobserved confounding variables that influence both online enrollment and course success. Specifically, we are using the direct-line

² In the MIS, multiple session records may be reported for the same section of a course if multiple methods of instruction are used for the section. In determining the method of instruction to assign to a course section, we used the predominant mode of delivery in terms of time spent. Specifically, we classify a section as online if at least 80 percent of the instruction is Internet-based.

³ The application of nonlinear fixed effects models in econometrics has often been avoided for two reasons: (1) the incidental parameters problem (which arises from the fact that the number of regressors increases with N) raises questions about the statistical properties of the estimator, and (2) it is computationally challenging to estimate nonlinear models with possibly thousands of coefficients. Strictly speaking, fixed effects probit models are inconsistent. However, there is only a very small amount of empirical evidence and very little theoretical foundation on how serious this problem is in practical terms (Greene 2002). As a robustness check, we estimated our specifications using linear probability models and we got similar results.

distance between the student’s home zip code centroid and the college of attendance given that information on the student’s home address was not available.⁴ This specification was estimated using a maximum-likelihood bivariate probit approach given the binary nature of both our dependent variable and our treatment.⁵

Table B7 presents the estimated marginal effects of online delivery format on student success across the different specifications described above. Our estimates suggest that online delivery format had a significant negative effect on student course success. Without controlling for anything, we find that the course success rates in online sections were 7.4 percentage points lower than in face-to-face sections. This gap was magnified once we added term, college, and subject fixed effects (10.9 percentage points) and even more so when we added course-by-college fixed effects (11.4 percentage points). The estimates became noticeably stronger (14 percentage points) after we accounted for unobservables, providing evidence that online sections are more popular among more motivated and academically better prepared students.

Robustness Checks

We performed multiple robustness checks to our estimates (Table B8). First, to address the concern that students on the quarter system have less time to adapt to the online setting, resulting in worse outcomes, we excluded three community colleges (Lake Tahoe, De Anza, and Foothill). Second, we excluded all courses offered in the winter terms (which are offered in 26 community colleges during our period of analysis). Third, to address the concern that educational motivation may be particularly relevant in the context of community colleges given the wide variation in their students’ educational intent, we limited our sample to those students who showed “behavioral intent to transfer.”⁶ Fourth, to address student selection into a particular course format based on preexisting knowledge regarding online courses or their likely performance in these courses, we limited our sample to only courses taken in the fall term of 2006. Fifth, we excluded students who took more than 80 percent of their units online given that one potential concern is that our results may be driven by the small share of individuals who took a high proportion of their units online. Sixth, to address the concern that distance could be endogenous for those courses that were taken at a school that was not the student’s primary college, we excluded enrollments in those courses. Seventh, to ensure that the results did not reflect the effectiveness of online courses in particular schools, we excluded the colleges with the largest online enrollment (in terms of the number of online enrollments or the share of online enrollment in total enrollments). Eighth, we excluded basic skills courses. Ninth, we excluded enrollment in repeated courses. Tenth, we excluded all physical education courses. Finally, to address the concern that we are relying in a cohort that entered college seven years ago and online course technologies may have evolved resulting in improved outcomes over face-to-face courses, we used instead the cohort of first-time students in the fall term of 2009 . Our estimated effect on online learning was robust to all of these checks.

Estimating the Overall Effect of Online Learning on Course Withdrawal

Grade distribution data show us that students enrolled in online courses not only are more likely to fail but also are also more likely to withdraw without permission and without having achieved a final passing grade

⁴ Two other issues arise in the calculation of our instrument. First, we identified nine colleges with more than one campus. Given that we do not have a way to determine which campus each student actually attended, we used the distance to the college main campus. Second, we cannot be certain that the students are reporting the zip codes where they actually live or their parents’ home zip codes. To minimize this concern, we excluded students who lived 100 miles or more away from their college of attendance. Data on zip code centroids coordinates come from SASHELP.ZIPCODE.

⁵ Chiburis , Das, and Lokshin 2011.

⁶ See Table B4 for the definition of behavioral intent to transfer.

than students enrolled in traditional courses. According to 2011–12 data, 17 percent of online students withdrew from a course versus 12 percent of students enrolled in traditional courses. 12.6 percent of students fail in online courses versus 8.5 percent in traditional courses.

To assess the potential effects on course withdrawal of taking a course online rather than face-to-face, we explore two additional outcomes: (1) course completion, that is, whether a student remained in the course to the end of the term; and (2) course success among those who completed the course. These results are presented in Table B9. The negative effect of online learning is significantly smaller on course completion than on course success. Once we address student self-selection into online courses, online course completion rates were 2.3 percentage points lower than face-to-face completion rates. However, among students who completed the course, online success rates were 13.5 percentage points lower.

Contrary to what we observe in the case of course success, the effect of online learning on course completion becomes weaker after controlling for observed and unobserved student characteristics. These results seem to support the idea that high withdrawal rates in online courses are due to self-selection bias, and therefore descriptive comparisons tend to overestimate the gap in completion rates between online and traditional courses, which is the opposite of what we find in terms of student course success.

In other words, these results seem to be suggesting that that more-advantaged students are more likely to choose online course sections, but less-advantaged students are more likely to stay to the end of the course even if they were failing.

Empirical Strategy for Estimating Online Performance Gaps for Different Types of Students

In this section, we compare student performance in online course sections to their own performance in face-to-face course sections. For this analysis, we include all the courses taken by those students in the 2006 cohort who were ever enrolled in an online course section during our period of analysis. Easing the restriction of including only courses offered through both online and face-to-face sections yields a sample of 1,773,117 enrollments (13.8% in online courses). In these models, we use individual fixed effects (π_i) to account for unobservable time-invariant student characteristics, such as their ability or motivation, that could be correlated with course delivery format. The use of student fixed effects eliminates the influence of unobserved individual characteristics from the online treatment estimate; therefore, it helps minimize any bias associated with the nonrandom distributions of students in online courses. To account for differences in online course availability across time and subjects, we also include subject and term fixed effects to this specification. Furthermore, given that some students attended more than one college, we added college fixed effects too. We estimated separate linear probability models including an interaction term between the given student attribute and section delivery format. This interaction term represents the difference in online learning between the reference group and the comparison group⁷.

$$Student\ success_{ijtkm} = \alpha + \beta Online_{ijtkm} + \psi(Online_{ijtkm} * X_i) + \delta Z_{it} + \pi_i + \tau_t + \theta_m + \gamma_j + \mu_{ijtkm} \quad (4)$$

⁷ Controlling for student fixed effects requires estimating a very large number of coefficients, which is easier to address within the framework of linear probability models than with probit models. Moreover, we estimated the overall effect of online learning using both frameworks and found that qualitatively, both methods yields similar results.

The estimated coefficient for online learning was negative for each type of student (Table B10). However, the magnitude of the effect varied considerably across types of students (i.e., the online performance gap might be wider or narrower for some students than for others). Our estimates suggest that younger students, males, Latinos, and African Americans have a harder time succeeding in online sections than in face-to-face sections. The online performance gap among full-time students is significantly narrower than among part-time students. Even though both types of students perform better in face-to-face sections, the gap in success rates between online and face-to-face sections is -6.9 percent for full-time students and -16.5 percent for those enrolled part-time. Students who already have a college degree, those who have showed behavioral intent to transfer to a four-year institution, and those with GPAs greater than 3.0 also seem to experience weaker online performance gaps than less academically prepared students, which is not surprising given that these students also tend to perform better overall.

Empirical Strategy for Estimating Online Performance Gaps across Academic Subject Areas

For estimating differences across academic subject areas in the effect of online delivery format on student course success, we included a set of interaction terms between subject area and online delivery format.

$$Student\ success_{ijtkm} = \alpha + \beta Online_{ijtkm} + \psi(Online_{ijtkm} * \theta_m) + \delta Z_{it} + \pi_i + \tau_t + \theta_m + \gamma_j + \mu_{ijtkm} \quad (5)$$

In every academic subject area, students were more likely to perform worse in their online sections than they did in their face-to-face sections. However, the gap between the two delivery methods was narrower in some subject areas than in others.

The subject areas in which the negative coefficients for online learning were weaker than average in terms of course success (indicating that the online performance gap was weaker in these subjects) were health, physical sciences, and biological sciences. Online enrollments represent less than 6 percent in physical sciences and biological sciences.

On the contrary, students in engineering and industrial technologies, public and protective services, and media and communications exhibited the largest online performance gap, indicating that there may have been intrinsic differences between subject areas in terms of the effectiveness of their online courses.

One potential explanation for the variation in online performance gaps across subject areas concerns the types of students who took online courses in each subject area. To address these concerns we further added interaction terms between online delivery format and student characteristics. The variation across subject areas in terms of online course effectiveness persisted after taking into account both the characteristics of students in each subject area and how those characteristics might differentially influence performance in online versus face-to-face courses (Table B11).

Empirical Strategy for Estimating Online Performance Gaps across Colleges

For estimating differences across community colleges in the effect of online delivery format on student course success, we included a set of interaction terms between colleges and online delivery format.

$$Student\ success_{ijtkm} = \alpha + \beta Online_{ijtkm} + \rho(Online_{ijtkm} * \gamma_j) + \delta Z_{it} + \pi_i + \tau_t + \theta_m + \gamma_j + \mu_{ijtkm} \quad (6)$$

Student success in online courses varies notably across colleges, with course success rates varying from around 50 percent for the five colleges with the lowest success rates to almost 70 percent for the colleges with the highest success rates (Coastline, Santa Monica, Pasadena City, Santa Barbara City, and Copper Mountain). However, at every one of the 112 community colleges in the California system, even those with relatively high success rates in online courses, success rates are lower for online courses than for traditional courses. It is possible that these differences in success rates are due to the mix of students and types of courses offered at particular community colleges, among other factors. Once we control for these factors, however, the performance gap between online and traditional courses becomes larger (worse) for most colleges. In fact, in only a few colleges the online performance gap is substantially reduced once we take into account student characteristics and other factors. In two colleges, Coastline and Pasadena City, we observe relatively high success rates in both online and traditional courses, with relatively small differences between the two, and in a third large college, we see relatively high online success rates (even after we control for a multitude of factors).

Empirical Strategy for Estimating the Relationship between Long-Term Student Outcomes and Online Learning

We use the proportion of units taken online as a predictor of the likelihood of earning an associate's degree, a Chancellor's Approved Certificate, or transfer to a four-year institution. We control for an array of factors: student demographic characteristics, student academic performance during his or her college career, and the fact that some community colleges have higher completion/transfer rates than others. Specifically, our models include dummy variables for college of attendance, gender, race/ethnicity, age, citizenship status, dual enrollment, disability status, academically disadvantaged status, highest level of education at enrollment, enrollment in more than one college, ever enrolled in basic skills courses, behavioral intent to transfer, economically disadvantaged status, and other financial aid. In terms of proxies for academic performance, we include the following variables: number of terms enrolled, full-time status, percentage of credits earned relative to the number of credits attempted, share of earned units taken online, and, finally, a set of interaction terms between share of units taken online and dummy variables for different thresholds for total units completed (Table B12).⁸

However, given that we are unable to control for the possible endogeneity of the variables that we are using or to correct for eventual self-selection biases, caution is necessary in making causal interpretations. Community colleges serve a diverse population of students with a broad range of educational goals. We restricted the analysis to degree/transfer-seeking students, excluding students whose stated goal was to take a few courses to acquire or update job skills, improve basic skills, etc.⁹ Our final sample for this analysis includes about 130,000 students in the 2006 cohort, one-third of whom took at least one course online during the six years we followed them.

⁸ Unfortunately, we do not have information on some of the most common factors used to explain student long-term outcomes. For example, prior academic performance (verbal or math test scores, matriculation examination results, high school GPA, etc.), student's family background (parents' educational level, family income, and social and economic status), delayed enrollment in higher education, marital status, number of children, employment status, and number of working hours.

⁹ We are using the informed goal of the student after participating in the matriculation process. Given that this is not a perfect measure, as a robustness check we replicated our analysis using the full cohort of students and the results were consistent.

Comparing our Estimates to Those in the Existing Literature

Our results are consistent with the evidence found by the Community College Research Center. In their first paper, Xu and Jaggars (2013a) explored the effect of online delivery on student course performance in the community college setting. Estimates across all model specifications suggest that the online format had a significant negative effect on both course completion and course grade. This relationship remained significant even when they used an instrumental variable approach and college-by-course fixed effects to address within- and between-course selection. In practical terms, these results indicate that for the typical student, taking a particular course in an online rather than face-to-face format would decrease his or her likelihood of course completion by 7 percentage points (e.g., from 95% to 88%) and, if the student persisted to the end of the course, would lower his or her final grade by more than 0.3 points (e.g., from 2.85 to 2.52).

In their second paper, Xu and Jaggars (2013b) focused on the performance gap between online and face-to-face courses and how the size of that gap differs across student subgroups and academic subject areas. Their results are based on students who first enrolled in any of Washington state's community and technical colleges during the fall of 2004. These students were tracked through spring or summer 2009, yielding observations on more than 40,000 degree-seeking students who collectively took about 500,000 courses. Their estimates show that all types of students in their study suffered decrements in performance in online courses; those with the strongest declines were males, younger, African American, and with lower grade point averages. In term of subject areas, their results suggest that, after controlling for individual and peer effects, students in social sciences and the applied professions (e.g., business, law, and nursing) showed the strongest online performance gaps.

Caveats

Relative to much of the other literature, our estimates are based on a very large sample of students and courses, include a large number of controls, and involve fairly sophisticated statistical analysis. To account for the possibility that students systematically sort between online and traditional sections of a single course, we use the distance from each student's home to his or her college of attendance as an instrument for the student's likelihood of enrolling in an online rather than traditional section. However, there was no random assignment of participants to one format or the other; therefore, the extent to which our results remain or not subject to selection bias depends on the quality of our instrument.

Additionally, we do not have information on what individual online sections entail in terms of quality or how much variation exists among the online sections offered by California's community colleges. Our estimates should be seen as an average performance gap across a wide range of online approaches. The effect of online learning for a given college will vary depending on the college's student demographic mix, its course quality standards, and the online technical support services that it offers, among other factors.

Appendix B. Figures and Tables

FIGURE B1
Success rates over time in online sections versus traditional sections, by race/ethnicity

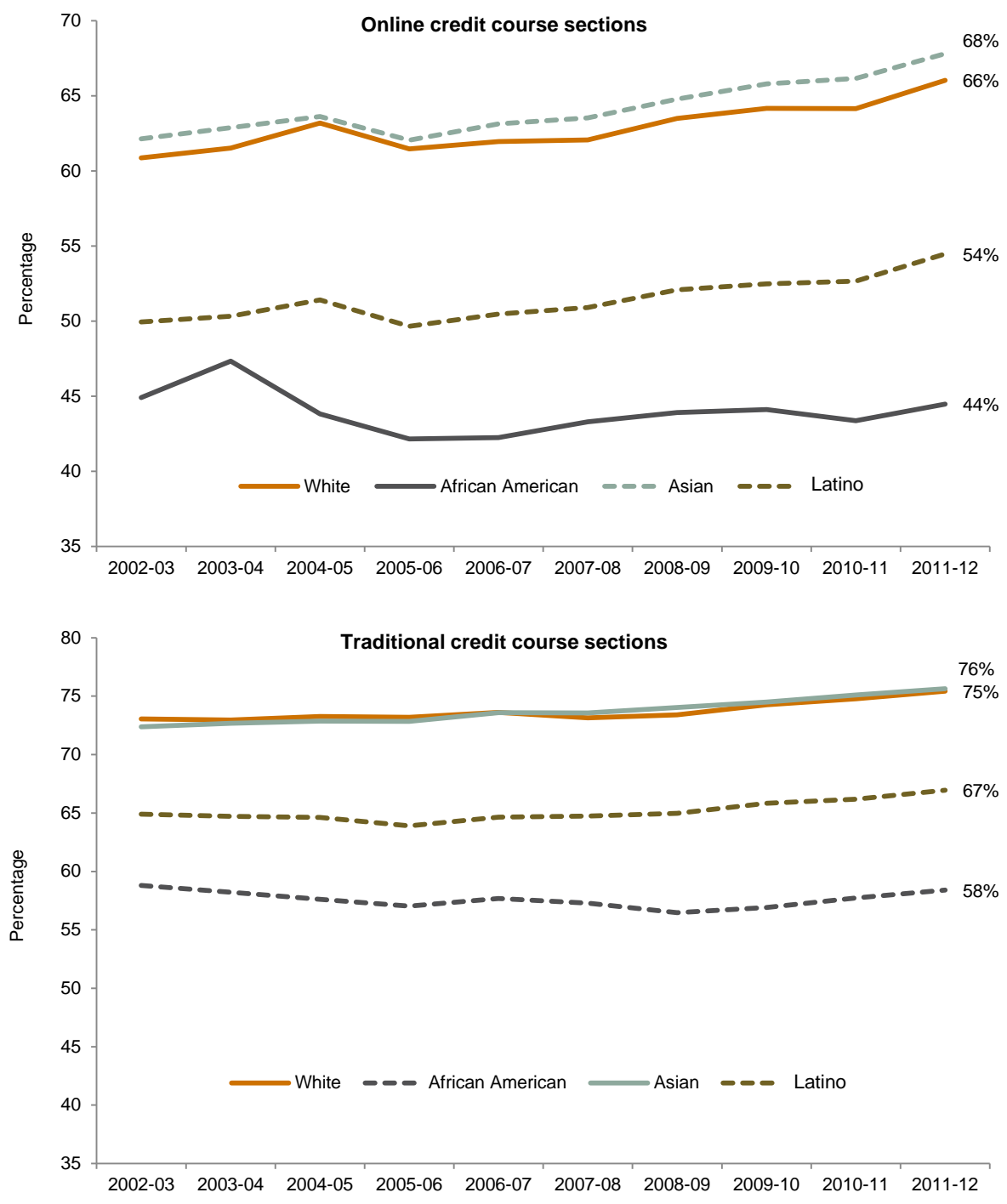


FIGURE B2
Success rates over time in online sections, by gender

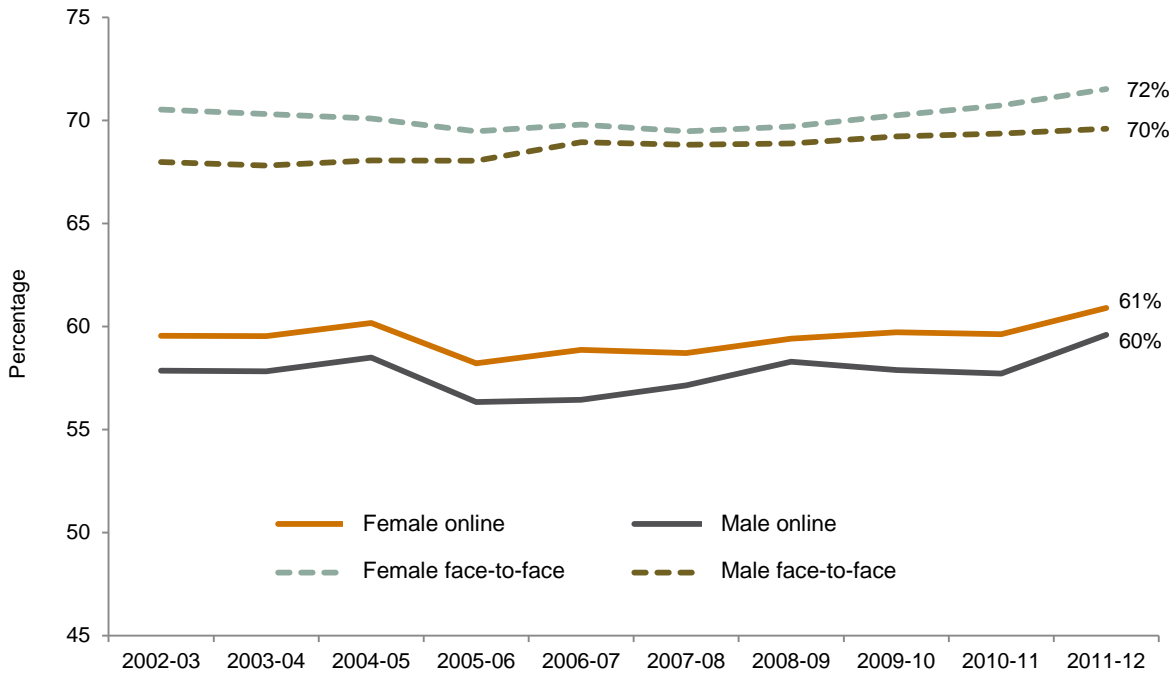


FIGURE B3
Success rates over time in online sections, by age

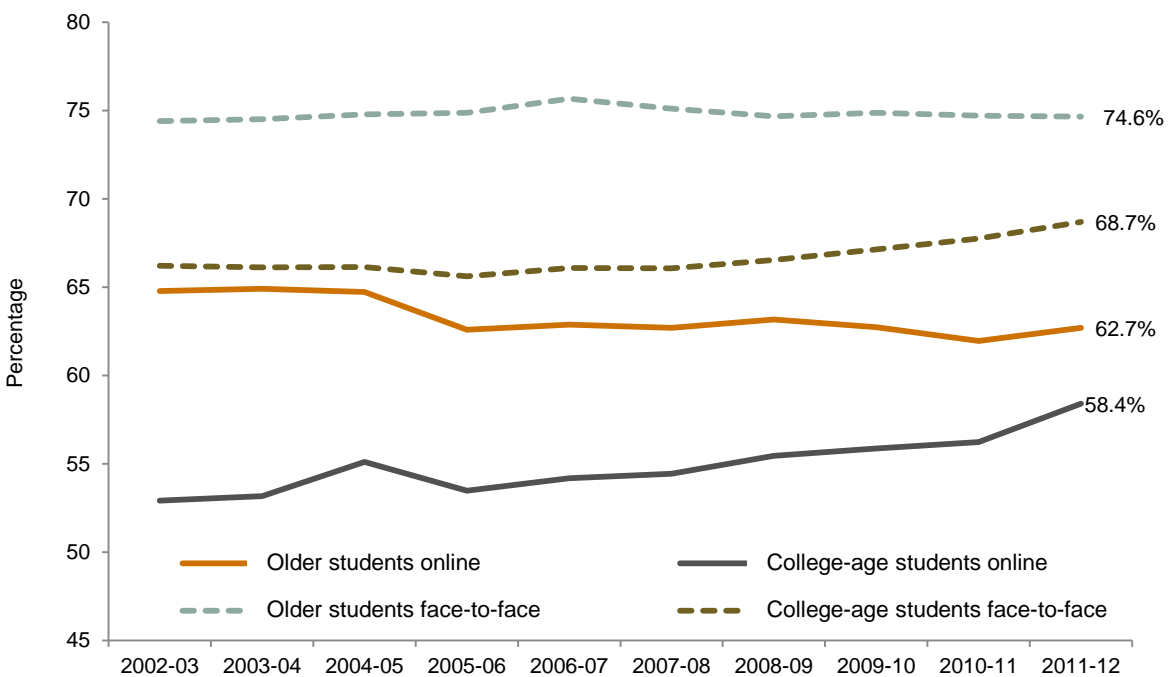


TABLE B1
Enrollment, by course section type

	All sections	Traditional sections	Online sections	Blended sections	Fully other sections	Blended other sections
Enrollment count						
2002–03	8,405,435	8,074,195	114,393	2,814	194,024	20,009
2003–04	8,174,474	7,811,191	167,538	7,198	167,252	21,295
2004–05	8,130,523	7,670,969	249,373	10,547	167,340	32,294
2005–06	8,206,159	7,566,281	399,075	13,768	179,087	47,948
2006–07	8,500,525	7,735,746	526,320	17,577	176,069	44,813
2007–08	9,254,691	8,111,267	728,328	32,432	345,011	37,653
2008–09	9,931,669	8,718,936	892,874	53,951	227,690	38,218
2009–10	9,794,776	8,592,497	929,470	77,578	171,517	23,714
2010–11	9,627,218	8,378,777	990,303	100,348	151,574	6,216
2011–12	8,959,319	7,790,510	957,888	85,454	119,328	6,139
Share in total enrollment (%)						
2002–03	100.0	96.1	1.4	0.0	2.3	0.2
2003–04	100.0	95.6	2.0	0.1	2.0	0.3
2004–05	100.0	94.3	3.1	0.1	2.1	0.4
2005–06	100.0	92.2	4.9	0.2	2.2	0.6
2006–07	100.0	91.0	6.2	0.2	2.1	0.5
2007–08	100.0	87.6	7.9	0.4	3.7	0.4
2008–09	100.0	87.8	9.0	0.5	2.3	0.4
2009–10	100.0	87.7	9.5	0.8	1.8	0.2
2010–11	100.0	87.0	10.3	1.0	1.6	0.1
2011–12	100.0	87.0	10.7	1.0	1.3	0.1
Annual growth rates (%)						
2002–03						
2003–04	-2.7	-3.3	46.5	155.8	-13.8	6.4
2004–05	-0.5	-1.8	48.8	46.5	0.1	51.7
2005–06	0.9	-1.4	60.0	30.5	7.0	48.5
2006–07	3.6	2.2	31.9	27.7	-1.7	-6.5
2007–08	8.9	4.9	38.4	84.5	96.0	-16.0
2008–09	7.3	7.5	22.6	66.4	-34.0	1.5
2009–10	-1.4	-1.5	4.1	43.8	-24.7	-38.0
2010–11	-1.7	-2.5	6.5	29.4	-11.6	-73.8
2011–12	-6.9	-7.0	-3.3	-14.8	-21.3	-1.2
Success rates (%)						
2002–03	69.1	69.4	58.9	58.9	63.2	77.9
2003–04	68.9	69.2	58.9	58.7	63.1	78.8
2004–05	68.8	69.2	59.6	57.4	64.7	76.0
2005–06	68.2	68.8	57.5	56.3	65.6	72.5
2006–07	68.6	69.4	58.0	60.2	66.6	72.6
2007–08	68.1	69.2	58.2	60.5	64.9	68.0
2008–09	68.2	69.3	59.0	59.8	64.6	69.4
2009–10	68.6	69.8	59.1	61.0	64.3	68.0
2010–11	68.8	70.1	59.0	61.4	67.6	69.2
2011–12	69.4	70.6	60.4	63.2	67.1	65.5

NOTES: "Fully other sections" refers to tutoring, work experience, directed study, field experience, or other independent study sections. "Blended other sections" refers to sections offered through a mix of distance education and either tutoring, work experience, directed study, field experience, or other independent study sections.

TABLE B2

Enrollment and success rates in online sections versus traditional sections, by subject area, 2011–12

Subject area	Enrollment			Share in total enrollment		Success rates		
	Online sections	Traditional sections	Total	Online sections (%)	Traditional sections (%)	Online sections (%)	Traditional sections (%)	Difference (percentage points)
Agriculture and natural resources	2,567	58,499	63,259	4.1	92.5	59.8	76.5	16.7
Architecture and related technologies	930	18,790	19,841	4.7	94.7	61.1	71.7	10.6
Environmental sciences and technologies	1,548	20,471	22,589	6.9	90.6	69.1	77.5	8.4
Biological sciences	14,425	289,285	312,377	4.6	92.6	64.3	67.9	3.6
Business and management	159,445	350,504	528,395	30.2	66.3	60.3	67.7	7.4
Media and communications	24,242	122,628	152,829	15.9	80.2	61.7	73.1	11.4
Information technology	78,317	132,317	231,983	33.8	57.0	60.6	66.2	5.7
Education	50,615	711,947	776,017	6.5	91.7	63.7	76.8	13.1
Engineering and industrial technologies	6,211	260,862	273,179	2.3	95.5	58.1	79.6	21.5
Fine and applied arts	60,098	664,495	735,731	8.2	90.3	64.7	73.7	9.0
Foreign language	14,484	204,512	222,447	6.5	91.9	60.2	70.5	10.2
Health	19,010	247,275	272,108	7.0	90.9	77.7	84.8	7.2
Family and consumer sciences	51,219	299,314	359,883	14.2	83.2	64.0	73.6	9.7
Law	3,654	25,213	30,039	12.2	83.9	66.7	73.7	7.0
Humanities (letters)	103,769	1,215,870	1,346,628	7.7	90.3	59.1	69.6	10.6
Library science	13,029	9,019	22,596	57.7	39.9	65.9	66.7	0.8
Mathematics	56,595	876,316	950,964	6.0	92.2	46.0	56.7	10.7
Military studies	0	240	240	0.0	100.0		72.5	72.5
Physical sciences	15,076	320,690	340,721	4.4	94.1	63.2	69.1	5.9
Psychology	53,396	293,644	353,508	15.1	83.1	61.8	69.2	7.4
Public and protective services	28,771	335,105	370,573	7.8	90.4	60.4	84.7	24.4
Social sciences	174,226	957,610	1,152,269	15.1	83.1	58.6	66.6	8.0
Commercial services	1,434	27,510	29,361	4.9	93.7	63.5	81.8	18.2
Interdisciplinary studies	24,827	348,394	391,782	6.3	88.9	63.3	74.7	11.4
Total	957,888	7,790,510	8,959,319	10.7	87.0	60.4	70.6	10.2

TABLE B3

Enrollment and success rates in online sections versus traditional sections, by individual community colleges, 2011–12

College	Enrollment			Share in total enrollment		Success rates		
	Online sections	Traditional sections	Total	Online sections (%)	Traditional sections (%)	Online sections (%)	Traditional sections (%)	Difference (percentage points)
Cuyamaca	6,826	35,582	43,757	15.6	81.3	62.1	72.3	10.2
Grossmont	10,296	96,220	108,252	9.5	88.9	58.2	70.7	12.5
Imperial Valley	2,178	47,497	49,823	4.4	95.3	59.1	70.8	11.7
Mira Costa	17,542	67,745	85,623	20.5	79.1	65.2	72.7	7.5
Palomar	15,185	131,639	150,960	10.1	87.2	61.4	69.4	8.0
San Diego City	12,143	69,601	82,780	14.7	84.1	52.7	66.5	13.8
San Diego Mesa	15,168	109,937	126,417	12.0	87.0	56.9	69.7	12.9
San Diego Miramar	11,622	42,670	54,613	21.3	78.1	59.3	77.0	17.7
Southwestern	0	122,668	122,668	0.0	100.0		66.8	66.8
Butte	5,182	81,994	87,819	5.9	93.4	61.3	71.4	10.1
Feather River	820	8,941	13,696	6.0	65.3	58.5	77.3	18.8
Lassen	457	10,423	16,237	2.8	64.2	57.1	77.1	20.0
Mendocino	3,815	17,482	21,594	17.7	81.0	62.2	72.7	10.5
Redwoods	3,969	30,964	35,594	11.2	87.0	62.8	67.5	4.6
Shasta	9,578	42,992	57,739	16.6	74.5	66.9	71.6	4.7
Siskiyou	3,581	11,043	15,897	22.5	69.5	57.4	74.0	16.6
Lake Tahoe	3,395	15,668	19,161	17.7	81.8	61.3	78.5	17.3
American River	24,265	148,590	178,443	13.6	83.3	65.1	70.9	5.8
Cosumnes River	12,108	69,853	84,520	14.3	82.6	58.5	66.1	7.6
Sacramento City	13,607	119,115	134,723	10.1	88.4	62.6	65.9	3.3
Folsom Lake	5,420	37,941	45,034	12.0	84.2	65.3	73.1	7.8
Napa Valley	3,284	34,675	38,130	8.6	90.9	55.7	75.3	19.6
Santa Rosa	15,273	127,524	144,951	10.5	88.0	66.8	73.3	6.5
Sierra	13,862	103,423	119,800	11.6	86.3	63.9	72.7	8.7
Solano	10,457	52,055	63,266	16.5	82.3	56.7	65.5	8.7
Yuba	5,897	39,841	46,716	12.6	85.3	60.5	68.3	7.8
Woodland	846	12,744	13,762	6.1	92.6	43.1	69.2	26.1
Contra Costa	1,786	44,801	48,752	3.7	91.9	56.8	66.8	10.0
Diablo Valley	14,206	117,707	136,486	10.4	86.2	64.2	73.7	9.4
Los Medanos	2,674	50,304	54,219	4.9	92.8	58.8	71.3	12.5
Marin	1,785	37,081	39,326	4.5	94.3	59.5	73.0	13.5
Alameda	4,125	24,383	28,516	14.5	85.5	51.4	66.6	15.2
Laney	4,361	58,072	62,767	6.9	92.5	54.8	65.9	11.0
Merritt	2,668	27,574	30,448	8.8	90.6	54.8	65.1	10.3
Berkeley City	3,640	28,938	32,637	11.2	88.7	57.5	65.0	7.5
San Francisco City	11,340	187,417	200,903	5.6	93.3	60.6	71.0	10.4
Cañada	2,411	32,426	36,208	6.7	89.6	54.4	70.9	16.6

College	Enrollment			Share in total enrollment		Success rates		
	Online sections	Traditional sections	Total	Online sections (%)	Traditional sections (%)	Online sections (%)	Traditional sections (%)	Difference (percentage points)
San Mateo	4,937	51,355	57,169	8.6	89.8	65.1	72.9	7.8
Skyline	6,376	52,112	60,326	10.6	86.4	59.3	71.8	12.5
Cabrillo	8,584	79,565	92,339	9.3	86.2	64.3	73.8	9.6
De Anza	16,546	181,390	200,513	8.3	90.5	60.3	75.1	14.8
Foothill	31,787	84,103	120,082	26.5	70.0	64.9	78.6	13.7
Ohlone	8,855	48,917	65,902	13.4	74.2	65.2	76.1	10.9
Gavilan	21	35,860	36,009	0.1	99.6	85.7	71.4	-14.3
Hartnell	5,633	55,459	62,225	9.1	89.1	50.3	71.0	20.7
Monterey	4,301	51,634	56,590	7.6	91.2	63.8	75.7	11.9
Evergreen Valley	2,104	55,016	57,451	3.7	95.8	52.5	72.0	19.5
San Jose City	4,078	50,291	54,759	7.4	91.8	59.3	67.5	8.2
Las Positas	6,109	43,818	50,733	12.0	86.4	63.3	72.3	9.0
Chabot	11,825	66,563	79,997	14.8	83.2	63.5	70.8	7.3
Mission	9,529	50,670	61,643	15.5	82.2	60.3	72.1	11.8
West Valley	18,581	56,204	76,005	24.4	73.9	51.7	71.3	19.6
Bakersfield	8,994	96,679	106,835	8.4	90.5	47.1	67.0	19.9
Cerro Coso	9,597	17,159	27,673	34.7	62.0	60.7	67.0	6.3
Porterville	2,541	22,085	25,313	10.0	87.2	51.7	69.3	17.6
Merced	0	65,688	70,614	0.0	93.0		68.0	68.0
San Joaquin Delta	24,270	101,726	127,939	19.0	79.5	55.5	65.7	10.2
Sequoias	5,736	63,891	70,861	8.1	90.2	55.0	69.1	14.1
Fresno City	3,368	119,435	123,670	2.7	96.6	64.2	69.2	5.1
Reedley	6,026	75,516	81,887	7.4	92.2	59.7	69.2	9.5
Coalinga	4,129	9,459	15,828	26.1	59.8	62.1	68.7	6.6
Lemoore	5,214	16,991	23,115	22.6	73.5	62.2	72.7	10.4
Columbia	1,724	14,642	16,761	10.3	87.4	59.0	71.2	12.1
Modesto	15,631	89,854	111,158	14.1	80.8	54.4	66.6	12.2
Allan Hancock	14,781	53,517	68,740	21.5	77.9	57.6	73.4	15.8
Antelope Valley	6,672	77,969	84,682	7.9	92.1	53.9	69.3	15.4
Cuesta	6,958	61,833	69,446	10.0	89.0	65.4	72.5	7.1
Santa Barbara City	18,858	105,063	130,654	14.4	80.4	68.0	76.3	8.3
Canyons	12,356	98,396	112,548	11.0	87.4	63.7	78.2	14.5
Moorpark	7,745	81,195	89,351	8.7	90.9	62.6	74.2	11.6
Oxnard	4,041	34,712	38,830	10.4	89.4	51.4	70.1	18.6
Ventura	9,366	76,368	85,871	10.9	88.9	56.6	70.8	14.2
Taft	7,923	23,167	31,703	25.0	73.1	56.2	83.7	27.5
Compton	6,328	39,972	46,326	13.7	86.3	55.6	62.9	7.3
El Camino	6,748	132,070	138,854	4.9	95.1	60.3	69.3	9.0
Glendale	8,386	85,086	93,472	9.0	91.0	64.5	70.7	6.2

College	Enrollment			Share in total enrollment		Success rates		
	Online sections	Traditional sections	Total	Online sections (%)	Traditional sections (%)	Online sections (%)	Traditional sections (%)	Difference (percentage points)
L.A. City	6,109	98,816	106,947	5.7	92.4	54.1	62.4	8.3
L.A. Harbor	6,064	55,938	63,973	9.5	87.4	56.4	65.6	9.2
L.A. Mission	2,471	44,208	48,583	5.1	91.0	63.7	65.7	2.1
L.A. Pierce	2,055	102,690	106,762	1.9	96.2	55.9	67.5	11.5
Southwest L.A.	2,629	28,266	31,129	8.4	90.8	44.8	59.4	14.6
L.A. Trade-Tech	3,250	74,811	78,956	4.1	94.8	50.8	66.7	15.9
L.A. Valley	6,181	89,095	97,760	6.3	91.1	54.9	67.4	12.5
East L.A.	10,504	163,823	176,020	6.0	93.1	52.1	68.4	16.3
West L.A.	14,995	41,761	59,769	25.1	69.9	56.1	60.5	4.4
Pasadena City	7,969	148,516	162,251	4.9	91.5	69.0	73.0	4.0
Santa Monica	23,133	175,482	200,749	11.5	87.4	69.1	70.2	1.1
Cerritos	14,444	121,620	136,893	10.6	88.8	59.2	71.3	12.1
Citrus	8,119	67,386	75,890	10.7	88.8	62.0	73.4	11.4
Coastline	38,446	13,769	63,623	60.4	21.6	69.4	79.8	10.4
Golden West	11,534	62,099	75,524	15.3	82.2	61.8	67.2	5.4
Orange Coast	8,464	136,103	148,025	5.7	91.9	61.9	71.0	9.0
Long Beach City	9,540	133,753	143,293	6.7	93.3	55.3	67.9	12.6
Mt. San Antonio	7,932	175,793	191,132	4.2	92.0	54.8	70.9	16.1
Cypress	9,719	78,162	88,978	10.9	87.8	66.9	73.8	6.8
Fullerton	8,887	98,599	108,504	8.2	90.9	58.7	71.4	12.7
Santa Ana	7,785	137,651	148,105	5.3	92.9	56.9	77.9	21.0
Santiago Canyon	5,470	61,052	66,581	8.2	91.7	56.4	74.9	18.4
Rio Hondo	16,601	92,625	114,673	14.5	80.8	50.7	68.4	17.7
Saddleback	27,229	112,987	143,935	18.9	78.5	63.7	73.3	9.6
Irvine Valley	9,704	67,805	77,990	12.4	86.9	63.0	71.2	8.1
Barstow	11,291	11,255	22,681	49.8	49.6	62.7	73.1	10.5
Chaffey	4,568	107,480	115,018	4.0	93.4	63.0	70.9	7.9
Desert	2,602	55,596	58,689	4.4	94.7	59.9	71.7	11.9
Mt. San Jacinto	14,109	67,336	84,080	16.8	80.1	62.0	70.6	8.6
Palo Verde	441	7,645	13,872	3.2	55.1	51.2	85.3	34.1
Riverside	13,865	90,248	105,594	13.1	85.5	56.1	68.0	11.8
Moreno Valley	1,980	43,048	45,235	4.4	95.2	55.1	73.9	18.8
Norco	4,406	41,609	46,360	9.5	89.8	57.0	70.4	13.4
Copper Mountain	949	11,140	12,318	7.7	90.4	67.5	69.1	1.5
Crafton Hills	780	30,370	31,647	2.5	96.0	65.5	72.9	7.4
San Bernardino	7,274	59,165	69,867	10.4	84.7	59.8	69.3	9.4
Victor Valley	13,959	59,848	77,268	18.1	77.5	57.9	65.5	7.5
Total	957,888	7,790,510	8,959,319	10.7	87.0	60.4	70.6	10.2

TABLE B4
Variable definitions

Variable	Description
Student outcomes (dependent variables)	
Grade equivalent	This variable is 4 if grade = A or A+; 3.7 if grade = A-; 3.3 if grade = B+; 3.0 if grade = B; 2.7 if grade = B-; 2.3 if grade = C+; 2.0 if grade = C; 1.3 if grade = D+; 1.0 if grade = D; and 0.7 if grade = D-; and 0 if grade = F
Completion	This variable is 1 if the student ended the term with a grade of A, B, C, D, F, P, NP, Incomplete (I*), Incomplete Pass (IPP), Incomplete No Pass (INP), Withdrawn without permission and without having achieved a final passing grade (FW) (SX04)
Success	This variable is 1 if completion is 1 <i>and</i> if the grade equivalent is 2.0 or higher (or grade = pass in a pass/not pass class)
Student demographic attributes	
Age	Student's age at a given term
College-age student	This variable is 1 if the student is age 24 or younger at first term
Gender	Categorical variables for female and unknown gender (male is the omitted category)
Race/ethnicity	Categorical variables for Latino, Asian or Pacific Islander, African American, other race, and unknown race (white is the omitted category)
Foreign born	Categorical variables for foreign born and unknown citizenship status (native is the omitted category)
Student academic preparedness proxies	
Highest level of education at first term	Categorical variables for not a high school graduate, college degree holder (associate's degree, bachelor's degree, or higher), and unknown education (high school diploma or equivalent is the omitted category)
Ever enrolled in a basic skills course	This variable is 1 if the student was ever enrolled in a basic skills course during his or her academic career (CB08=B)
Limited English proficiency status	This variable is 1 if the student has been ever enrolled in a basic skills course that had a course TOP Code (CB03) equal to 493084, 493085, 493086, 493087, or 493100 or if the student was identified at some time as needing English as a second language services in the eight positions of Student Matriculation Special Services Needs (SM03)
Disability status	This variable is 1 if the student was ever reported with at least one primary disability (SD01)
Academically disadvantaged status	This variable is 1 if the student meets at least one of the following criteria: (1) Had an enrollment at some time in his or her academic career that resulted in a code of B or S in derived data element Enrollment Credit Status (SXD2) on that enrollment record and the TOP Code of the course enrolled in indicated it was English or math basic skills. For this flag to be set using this criterion, the student cannot have a code of E in derived data element LEP student (SCD4). (2) Reported on academic probation or academic dismissal in data element student academic standing (SB22) at least once in his or her academic career. (3) Reported as having received services from the Extended Opportunity Programs and Services program some time in his or her academic career. (4) Has been identified by staff as needing basic skills instruction services by a flag in the sixth position in data element Student Matriculation Special Services Needs (SM03) at some time in his or her academic career
Prior dual enrollment	This variable is 1 if the student was previously enrolled as a special admit student (i.e., simultaneously enrolled in K-12)
Units 2006	Units earned during the student's first term (SX03)

Variable	Description
GPA 2006	Grade point average earned during the student's first term
Behavioral intent to transfer	This variable is 1 if the student earned at least 6 units and attempted a transfer-level math or English course (SX03 ≥ 6 and CB03 = 1701 1501* 1520* & CB21 = A B C D Y). These are the criteria that the Chancellor's Office uses to identify students with an intent to transfer to a four-year institution
Enrolled in more than one college	This variable is 1 if the student was enrolled in more than one college (in the CCC system) during his or her academic career
Course-prior-to-college-level	Categorical variables for course-level status: college ready, one level below, two levels below, three levels below, and four or more levels below transfer
Student socioeconomic proxies	
Economically disadvantaged status	This variable is 1 if the student received a Board of Governor's waiver or Pell grant (SF21), is a CalWorks participant (SC01) or Workforce Investment Act participant (SB26), or if the student was identified as economically disadvantaged in the Vocational and Technical Education Act (VTEA) file (SV3)
Financial aid recipient	This variable is 1 if the student received financial aid in the form of Board of Governors enrollment fee waiver, grants, loans, scholarships, or work to study funds
Other financial aid recipient	This variable is 1 if the student received financial aid in the form of non-Pell grants, loans, scholarships, or work to study funds
Term information	
Total units	Total units earned in a given term (SX03)
Full-time status	This variable is 1 if the student attempted 12 or more units in a term (SX03)

NOTES: The data element dictionary for the CCCC MIS provides a more detail description (CCCCO undated). The asterisk indicates the default grade to be received by the student if the incomplete is not completed within one year.

TABLE B5
Student characteristics

	Fall 2006 cohort (1)		Our sample of interest (2)		Ever online sample (3)		Never online sample (4)	
	Student count	%	Student count	%	Student count	%	Student count	%
Total	267,683	100	126,509	100	55,914	100	70,595	100
Age at first term								
15–19	147,517	55.1	80,336	63.5	35,958	64.3	44,378	62.9
20–24	39,203	14.6	29,035	23.0	11,604	20.8	17,431	24.7
25–29	19,717	7.4	6,356	5.0	3,196	5.7	3,160	4.5
30–34	13,306	5.0	3,217	2.5	1,705	3.0	1,512	2.1
35–39	12,202	4.6	2,474	2.0	1,193	2.1	1,281	1.8
40–44	10,854	4.1	1,964	1.6	925	1.7	1,039	1.5
45–49	9,768	3.6	1,533	1.2	705	1.3	828	1.2
50–54	7,298	2.7	918	0.7	382	0.7	536	0.8
55–59	5,009	1.9	473	0.4	190	0.3	283	0.4
60–64	2,809	1.0	177	0.1	54	0.1	123	0.2
65+			26	0.0	2	0.0	24	0.0
Gender								
Female	142,888	53.4	68,306	54.0	33,560	60.0	34,746	49.2
Male	123,284	46.1	57,784	45.7	22,182	39.7	35,602	50.4
Unknown	1,511	0.6	419	0.3	172	0.3	247	0.3
Race/ethnicity								
White	103,470	38.7	51,332	40.6	25,260	45.2	26,072	36.9
Latino	83,282	31.1	39,107	30.9	14,737	26.4	24,370	34.5
Asian	35,717	13.3	17,442	13.8	8,254	14.8	9,188	13.0
African American	22,218	8.3	9,656	7.6	3,641	6.5	6,015	8.5
Native American	2,713	1.0	1,243	1.0	548	1.0	695	1.0
Native Hawaiian or Other Pacific Islander	2,526	0.9	1,285	1.0	573	1.0	712	1.0
Two or more races	1,036	0.4	725	0.6	408	0.7	317	0.4
Unknown	16,721	6.2	5,719	4.5	2,493	4.5	3,226	4.6
Citizenship status								
U.S. citizen	235,992	88.2	115,832	91.6	51,461	92.0	64,371	91.2
Permanent resident	22,778	8.5	8,169	6.5	3,371	6.0	4,798	6.8
Temporary resident	1,186	0.4	355	0.3	128	0.2	227	0.3
Refugee/asylee	1,219	0.5	472	0.4	224	0.4	248	0.4
Student visa (F-1 or M-1 visa)	1,093	0.4	688	0.5	366	0.7	322	0.5
Other status	2,927	1.1	764	0.6	272	0.5	492	0.7
Unknown	2,488	0.9	229	0.2	92	0.2	137	0.2
Highest level of education								
Not a graduate or no longer enrolled in high school	14,108	5.3	2,620	2.1	1,008	1.8	1,612	2.3
Currently enrolled in adult school	2,631	1.0	455	0.4	170	0.3	285	0.4
High school diploma	186,364	69.6	107,357	84.9	47,703	85.3	59,654	84.5
Passed GED or received a high school certificate of equivalency/completion	11,089	4.1	3,942	3.1	1,673	3.0	2,269	3.2
California high school proficiency certificate	2,425	0.9	1,273	1.0	559	1.0	714	1.0

	Fall 2006 cohort (1)		Our sample of interest (2)		Ever online sample (3)		Never online sample (4)	
	Student count	%	Student count	%	Student count	%	Student count	%
Foreign secondary school diploma/certificate of graduation	9,585	3.6	2,860	2.3	1,290	2.3	1,570	2.2
Associate degree	5,970	2.2	1,801	1.4	991	1.8	810	1.1
Bachelor's degree or higher	20,741	7.7	2,694	2.1	1,426	2.6	1,268	1.8
Unknown	14,770	5.5	3,507	2.8	1,094	2.0	2,413	3.4
Previous dual enrollment								
0	236,910	88.5	107,357	84.9	46,826	83.7	60,531	85.7
1	30,773	11.5	19,152	15.1	9,088	16.3	10,064	14.3
Enrolled for one term only								
0	210,604	78.7	126,509	100	55,914	100	70,595	100
1	57,079	21.3	0	0.0	0	0.0	0	0.0
Day/evening status at the end of the term								
Day student	197,688	73.9	111,660	88.3	47,662	85.2	63,998	90.7
Evening student	54,607	20.4	10,779	8.5	5,053	9.0	5,726	8.1
Unknown	13,873	5.2	3,177	2.5	2,896	5.2	281	0.4
Not applicable	1,515	0.6	893	0.7	303	0.5	590	0.8
Economically disadvantaged status (any time during student's college career)								
0	119,455	44.6	37,548	29.7	15,651	28.0	21,897	31.0
1	148,228	55.4	88,961	70.3	40,263	72.0	48,698	69.0
Financial aid recipient (any time during student's college career)								
0	148,532	55.5	54,678	43.2	23,619	42.2	31,059	44.0
1	119,151	44.5	71,831	56.8	32,295	57.8	39,536	56.0
Other financial aid recipient—a recipient of a board of Governors Enrollment Fee Waiver or Pell Grant (any time during student's college career)								
0	236,643	88.4	103,764	82.0	45,135	80.7	58,629	83.0
1	31,040	11.6	22,745	18.0	10,779	19.3	11,966	17.0
Number of California community colleges attended during student's college career								
1	185,379	69.3	69,867	55.2	26,805	47.9	43,062	61.0
2	57,408	21.4	37,996	30.0	17,769	31.8	20,227	28.7
3	17,559	6.6	13,010	10.3	7,483	13.4	5,527	7.8
4	5,239	2.0	4,030	3.2	2,659	4.8	1,371	1.9
5	1,479	0.6	1,138	0.9	820	1.5	318	0.5
6	413	0.2	309	0.2	244	0.4	65	0.1
7	128	0.0	97	0.1	78	0.1	19	0.0
8	45	0.0	34	0.0	30	0.1	4	0.0
9	19	0.0	15	0.0	13	0.0	2	0.0
10 or more	14	0.0	13	0.0	13	0.0	0	0.0
Took at least one basic skills course (any time during student's college career)								
0	130,125	48.6	107,499	85.0	46,872	83.8	60,627	85.9
1	137,558	51.4	19,010	15.0	9,042	16.2	9,968	14.1

	Fall 2006 cohort (1)		Our sample of interest (2)		Ever online sample (3)		Never online sample (4)	
	Student count	%	Student count	%	Student count	%	Student count	%
Took a basic skills course in student's first term								
0	172,795	64.6	118,321	93.5	52,205	93.4	66,116	93.7
1	94,888	35.4	8,188	6.5	3,709	6.6	4,479	6.3
Behavioral intent to transfer								
0	178,897	66.8	73,079	57.8	27,055	48.4	46,024	65.2
1	88,786	33.2	53,430	42.2	28,859	51.6	24,571	34.8
Took at least one English as a Second Language course (any time during student's college career)								
0	250,527	93.6	122,045	96.5	54,223	97.0	67,822	96.1
1	17,156	6.4	4,464	3.5	1,691	3.0	2,773	3.9
Disability status								
0	254,600	95.1	119,355	94.3	53,230	95.2	66,125	93.7
1	13,083	4.9	7,154	5.7	2,684	4.8	4,470	6.3
Academically disadvantaged status								
0	130,087	48.6	40,517	32.0	18,616	33.3	21,901	31.0
1	137,596	51.4	85,992	68.0	37,298	66.7	48,694	69.0
Units earned in student's first term								
0 Units	71,979	26.9	11,497	9.1	4,348	7.8	7,149	10.1
0.1–2.9	23,463	8.8	4,106	3.2	1,502	2.7	2,604	3.7
3.0–5.9	56,882	21.2	24,663	19.5	10,276	18.4	14,387	20.4
6.0–8.9	37,378	14.0	24,420	19.3	10,463	18.7	13,957	19.8
9.0–11.9	30,038	11.2	23,177	18.3	10,628	19.0	12,549	17.8
12.0–14.9	36,935	13.8	29,908	23.6	14,365	25.7	15,543	22.0
15 +	11,008	4.1	8,738	6.9	4,332	7.7	4,406	6.2
Took only noncredit courses								
0	256,599	95.9	126,509	100	55,914	100	90,842	128.7
1	11,084	4.1	0	0.0	0	0.0	0	0.0
Took at least one online course								
0	183,782	68.7	70,595	55.8	0	0.0	70,595	100
1	83,901	31.3	55,914	44.2	55,914	100	0	0.0
Share of units taken online of total units earned								
0 units online	165,246	61.7	84,458	66.8	15,677	28.0	68,781	97.4
> 0 and ≤ 5%	12,153	4.5	10,301	8.1	10,301	18.4		0.0
> 5 and ≤ 10%	13,107	4.9	10,471	8.3	10,471	18.7		0.0
> 10 and ≤ 20%	14,065	5.3	9,791	7.7	9,791	17.5		0.0
> 20 and ≤ 30%	6,613	2.5	3,938	3.1	3,938	7.0		0.0
> 30 and ≤ 40%	3,676	1.4	2,118	1.7	2,118	3.8		0.0
> 40 and ≤ 50%	2,803	1.0	1,365	1.1	1,365	2.4		0.0
> 50 and ≤ 60%	1,311	0.5	571	0.5	571	1.0		0.0
> 60 and ≤ 70%	1,001	0.4	367	0.3	367	0.7		0.0

	Fall 2006 cohort (1)		Our sample of interest (2)		Ever online sample (3)		Never online sample (4)	
	Student count	%	Student count	%	Student count	%	Student count	%
> 70 and ≤ 80%	786	0.3	224	0.2	224	0.4		0.0
> 80 and ≤ 90%	453	0.2	83	0.1	83	0.1		0.0
> 90 and ≤ 100%	3,133	1.2	433	0.3	433	0.8		0.0
The student earned 0 total units	43,336	16.2	2,389	1.9	575	1.0	1,814	2.6

NOTES: (1) Includes only students with known birth dates and who were born between 1942 and 1991, that is, only students ages 15 to 64 as of the fall semester of 2006 (we followed these students until the fall term of 2012). First-term enrollment is defined as the first time the student appeared in the enrollment file as a non-special admit student (Education Status SB11 not = 10000). We include only students with a valid Social Security Number. (2) Includes only students enrolled in credit courses that offer online and face-to-face sections. We exclude students enrolled for only one term and students with missing GPA in their first term. (3) Includes students who took at least one online course during their college career. (4) Includes students who never took an online course during their college career.

TABLE B6
Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Fall 2006 cohort					
Units per term	267,683	5.22	4.22	0	34.4
Total number of terms enrolled	267,683	5.35	4.23	1	39
Total number of units earned	267,683	30.80	34.46	0	255
Grade equivalents	229,391	2.39	1.15	0	4.0
Grade points	229,388	7.22	4.64	0	160
Total grade points	267,683	14.61	13.62	0	120
Student's GPA	229,391	2.56	1.08	0	4.0
Total number of degree-applicable units	248,032	30.47	33.08	0	248.5
Units earned in the first term	267,683	5.32	5.05	0	52
Grade points in the first term	267,683	14.27	15.61	0	159
Student's GPA in the first term	205,416	2.52	1.28	0	4
Number of units taken online	267,683	1.96	5.70	0	123
Number of units taken face-to-face	267,683	28.85	32.70	0	255
Share of online units in total units	224,347	5.85	16.09	0	100
Distance from student's home to college	258,202	10.02	11.22	0.05	99.93
Our sample of interest					
Units per term	126,509	7.27	4.25	0	38.1
Total number of terms enrolled	126,509	7.70	4.00	1	26
Total number of units earned	126,509	51.02	34.83	0	255
Grade equivalents	119,488	2.29	1.17	0	4.0
Grade points	119,488	7.31	3.89	0	20.0
Total grade points	126,509	20.70	14.48	0	129.6
Student's GPA	122,677	2.58	0.95	0	4.0
Total number of degree-applicable units	124,958	12.64	11.88	0	86.5
Units earned in the first term	126,509	7.98	4.76	0	52
Grade points in the first term	126,509	21.61	15.65	0	159
Student's GPA in the first term	126,509	2.54	1.15	0	4
Number of units taken online	126,509	2.34	5.19	0	76

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Number of units taken face-to-face	126,509	10.67	10.64	0	78
Share of online units in total units	124,120	4.92	11.80	0	100
Distance from student's home to college	123,312	9.64	10.27	0.05	99.99
Ever online sample					
Units per term	55,914	7.70	4.00	0	38.1
Total number of terms enrolled	55,914	8.66	3.93	1	26
Total number of units earned	55,914	59.06	34.11	0	254.5
Grade equivalents	54,383	2.41	1.07	0	4.0
Grade points	54,383	7.65	3.56	0	20.0
Total grade points	55,914	22.45	13.88	0	129.6
Student's GPA	55,084	2.68	0.86	0	4.0
Total number of degree-applicable units	54,931	16.81	12.98	0	86.5
Units earned in the first term	55,914	8.37	4.74	0	52
Grade points in the first term	55,914	23.23	15.77	0	159
Student's GPA in the first term	55,914	2.64	1.11	0	4
Number of units taken online	55,914	5.30	6.72	0	76
Number of units taken face-to-face	55,914	11.98	11.23	0	78
Share of online units in total units	55,339	11.04	15.64	0	100
Distance from student's home to college	54,019	10.16	10.35	0.15	99.85
Never online sample					
Units per term	70,595	6.92	4.41	0	31.5
Total number of terms enrolled	70,595	6.95	3.90	1	25
Total number of units earned	70,595	44.65	34.07	0	255
Grade equivalents	65,105	2.19	1.23	0	4.0
Grade points	65,105	7.03	4.12	0	20.0
Total grade points	70,595	19.31	14.79	0	105.5
Student's GPA	67,593	2.50	1.01	0	4.0
Total number of degree-applicable units	70,027	9.36	9.76	0	73
Units earned in the first term	70,595	7.68	4.76	0	27.5
Grade points in the first term	70,595	20.33	15.43	0	108
Student's GPA in the first term	70,595	2.46	1.18	0	4
Number of units taken online	70,595	0.00	0.00	0	0
Number of units taken face-to-face	70,595	9.64	10.03	0	76
Share of online units in total units	68,781	0.00	0.00	0	0
Distance from student's home to college	69,293	9.23	10.19	0.0	100.0

TABLE B7

Regression estimates of the effect of online delivery format on student course success

	No controls	Student characteristics	Adding term fixed effects	Adding term and college fixed effects	Adding term, college, and subject fixed effects	Adding college by course fixed effects	Biprobit plus term, college, and subject fixed effects	Biprobit plus course fixed effects
Estimated coefficient	-0.194 (0.009)***	-0.247 (0.008)***	-0.312 (0.008)***	-0.328 (0.008)***	-0.371 (0.008)***	-0.398 (0.008)***	-0.456 (0.047)***	-0.489 (0.035)***
Marginal effect	-0.074 (0.003)***	-0.076 (0.002)***	-0.094 (0.002)***	-0.098 (0.002)***	-0.109 (0.002)***	-0.114 (0.002)***	-0.134 (0.014)***	-0.140 (0.010)***
Observations	757,544	757,544	757,544	757,544	757,544	757,544	729,304	729,304

NOTES: Each column represents a different regression. We cluster standard errors at the course level to account for potential within-course error correlation. All models include dummy variables for college-age, gender, race/ethnicity, nativity status, economically disadvantaged status, other financial aid recipient, highest level of education at the time of initial enrollment, prior dual enrollment, ever enrolled in basic skill courses, full-time status, disability status, academically disadvantaged status, intent to transfer, and enrolled in more than one college. We also include student GPA in their first term. In the instrumental variable models (last two columns), we lost 3.7 percent of our sample because some students had missing information on zip codes (10,089 enrollments), invalid zip codes (1,120), out-of-state zip codes (5,919), or lived 100 miles or more away from their college of attendance (11,112). *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE B8
Robustness checks

	Baseline	(1)	(2)	(3)	(4)	(5)	(6)
Online delivery format	-0.456 (0.047)***	-0.463 (0.048)***	-0.450 (0.049)***	-0.459 (0.048)***	-0.609 (0.063)***	-0.362 (0.127)***	-0.475 (0.048)***
Marginal effect	-0.134 (0.014)***	-0.136 (0.014)***	-0.132 (0.014)***	-0.135 (0.014)***	-0.168 (0.017)***	-0.084 (0.029)***	-0.139 (0.014)***
Distance	0.006 (0.000)***	0.005 (0.000)***	0.005 (0.000)***	0.005 (0.000)***	0.005 (0.000)***	0.003 (0.001)***	0.006 (0.000)***
athrho	0.049 (0.027)*	0.052 (0.028)*	0.047 (0.028)*	0.052 (0.028)*	0.114 (0.037)***	-0.046 (0.063)	0.06 (0.028)**
Observations	729,304	718,828	716,225	723,411	442,522	103,880	700,405
Reduction in sample		-1.4	-1.8	-0.8	-39.3	-85.8	-4.0

	Baseline	(7)	(8a)	(8b)	(9)	(10)	(11)
Online delivery format	-0.456 (0.047)***	-0.455 (0.048)***	-0.476 (0.050)***	-0.473 (0.047)***	-0.439 (0.052)***	-0.510 (0.049)***	-0.294 (0.045)***
Marginal effect	-0.134 (0.014)***	-0.134 (0.014)***	-0.140 (0.015)***	-0.139 (0.014)***	-0.128 (0.015)***	-0.150 (0.014)***	-0.081 (0.012)***
Distance	0.006 (0.000)***	0.006 (0.000)***	0.005 (0.000)***	0.006 (0.000)***	0.004 (0.000)***	0.005 (0.000)***	0.007 (0.000)***
athrho	0.049 (0.027)*	0.049 (0.028)*	0.059 (0.029)**	0.06 (0.027)**	0.037 (0.030)	0.068 (0.028)**	-0.038 (0.025)
Observations	729,304	725,590	655,971	724,138	643,436	723,091	862,202
Reduction in sample		-0.5	-10.1	-0.7	-11.8	-0.9	18.2

NOTES: Each column represents a different regression. We cluster standard errors at the course level to account for potential within-course error correlation. All models include dummy variables for college-age, gender, race/ethnicity, nativity status, economically disadvantaged status, other financial aid recipient, highest level of education at the time of initial enrollment, prior dual enrollment, ever enrolled in basic skill courses, full-time status, disability status, academically disadvantaged status, intent to transfer, and enrolled in more than one college. We also include student GPA in their first term. In the instrumental variable models, we lost 3.7 percent of our sample because some students had missing information on zip codes (10,089 enrollments), invalid zip codes (1,120), out-of-state zip codes (5,919), or lived 100 miles or more away from their college of attendance (11,112). *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level. athrho is a Wald test of the exogeneity of the instrument variable. If the test is not significant, there is not sufficient information to reject the null that there is no endogeneity.

Specifications:

- (1) Excludes colleges that operate on the quarter system.
- (2) Excludes courses offered in the winter term.
- (3) Excludes enrollment in repeated courses.
- (4) Sample limited to students who show "behavioral intent to transfer."
- (5) Sample limited to only courses taken in the fall term of 2006.
- (6) Excludes basic skills courses.
- (7) Excludes PE courses.
- (8) Excludes colleges with the highest online enrollment in our sample in terms of: a) the number of online enrollments, and b) the share of online enrollment in total enrollments.
- (9) Excludes courses that were taken at a school that was not the student's primary college.
- (10) Excludes students who took more than 80 percent of their credits online.
- (11) Using the fall 2009 cohort.

TABLE B9

Regression estimates of the effect of online delivery format on student course outcomes

	No controls	Student characteristics	Adding term fixed effects	Adding term and college fixed effects	Adding term, college, and subject fixed effects	Adding college by course fixed effects	Biprobit plus term, college, and subject fixed effects	Biprobit plus course fixed effects
Course success								
Online delivery format	-0.194 (0.009)***	-0.247 (0.008)***	-0.312 (0.008)***	-0.328 (0.008)***	-0.371 (0.008)***	-0.398 (0.008)***	-0.456 (0.047)***	-0.489 (0.035)***
Marginal effect	-0.074 (0.003)***	-0.076 (0.002)***	-0.094 (0.002)***	-0.098 (0.002)***	-0.109 (0.002)***	-0.114 (0.002)***	-0.134 (0.014)***	-0.140 (0.010)***
Observations	757,544	757,544	757,544	757,544	757,544	757,544	729,304	729,304
Course completion								
Online delivery format	-0.233 (0.008)***	-0.236 (0.008)***	-0.256 (0.008)***	-0.278 (0.007)***	-0.313 (0.007)***	-0.337 (0.008)***	-0.141 (0.041)***	-0.104 (0.037)***
Marginal effect	-0.061 (0.002)***	-0.055 (0.002)***	-0.06 (0.002)***	-0.064 (0.002)***	-0.071 (0.002)***	-0.075 (0.002)***	-0.032 (0.009)***	-0.023 (0.008)***
Observations	757,544	757,544	757,544	757,544	757,544	757,206	729,304	729,304
Course success among completers								
Online delivery format	-0.105 (0.010)***	-0.178 (0.009)***	-0.255 (0.009)***	-0.264 (0.009)***	-0.301 (0.009)***	-0.323 (0.009)***	-0.533 (0.058)***	-0.557 (0.041)***
Marginal effect	-0.033 (0.003)***	-0.046 (0.002)***	-0.065 (0.002)***	-0.067 (0.002)***	-0.075 (0.002)***	-0.079 (0.002)***	-0.133 (0.014)***	-0.135 (0.010)***
Observations	621,531	621,531	621,531	621,531	621,531	621,392	598,100	598,100

NOTES: Each column/panel represents a different regression. We cluster standard errors at the course level to account for potential within-course error correlation. All models include dummy variables for college-age, gender, race/ethnicity, nativity status, economically disadvantaged status, other financial aid recipient, highest level of education at the time of initial enrollment, prior dual enrollment, ever enrolled in basic skill courses, full-time status, disability status, academically disadvantaged status, intent to transfer, and enrolled in more than one college. We also include student GPA in their first term. In the instrumental variable models (last two columns), we lost 3.7 percent of our sample because some students had missing information on zip codes (10,089 enrollments), invalid zip codes (1,120), out-of-state zip codes (5,919), or lived 100 miles or more away from their college of attendance (11,112). *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE B10

Difference in the estimated effect of online delivery format on student course success across subpopulation of students

	Estimates		Estimates
Online	-0.147*** (0.002)	Online	-0.138*** (0.001)
Online x female	0.011*** (0.003)	Online x prior dual enrollment	-0.009*** (0.003)
Online x unknown gender	0.033 (0.021)	Online	-0.127*** (0.002)
Online	-0.136*** (0.002)	Online x academically disadvantaged	-0.019*** (0.003)
Online x Latino	-0.023*** (0.003)	Online	-0.148*** (0.002)
Online x Asian	0.030*** (0.004)	Online x GPA>=3.0	0.016*** (0.002)
Online x African American	-0.043*** (0.005)	Online	-0.144*** (0.002)
Online x other race	-0.014 (0.010)	Online x enrolled in more than one college	0.007*** (0.002)
Online x unknown race	-0.006 (0.006)	Online	-0.165*** (0.002)
Online	-0.144*** (0.001)	Online x full-time	0.096*** (0.002)
Online x foreign-born	0.054*** (0.004)	Online	-0.142*** (0.002)
Online x unknown citizenship	-0.026 (0.032)	Online x economically disadvantaged	0.003 (0.002)
Online	-0.102*** (0.003)	Online	-0.140*** (0.001)
Online x college-age student	-0.043*** (0.004)	Online x other financial aid recipient	0.005 (0.004)
Online	-0.140*** (0.001)	Online	-0.142*** (0.001)
Online x disability status	-0.001 (0.006)	Online x less than high school	0.010 (0.009)
Online	-0.138*** (0.002)	Online x college degree	0.056*** (0.006)
Online x ever enrolled in basic skills	-0.005** (0.002)	Online x unknown education	0.001 (0.010)
Online	-0.166*** (0.002)		
Online x intent to transfer	0.035*** (0.003)		

NOTES: Each box represents a separate regression. The coefficient for online becomes the estimated gap between student success in online and face-to-face sections only for the reference group. The interaction term between online and each student attribute represents the difference in the gap between the reference group and the comparison group. Therefore, the coefficient for the comparison group is the sum of the coefficients for online and the interaction term. Standard errors clustered at the student level are shown in parentheses. All specifications include term, college, and subject fixed effects.

*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE B11

Difference in the estimated effect of online delivery format on student course success across course subject areas

	(1)	(2)
Online	-0.134*** (0.002)	-0.139*** (0.006)
Online x agriculture and natural resources	-0.026 (0.021)	-0.029 (0.021)
Online x architecture and related technologies	-0.037 (0.035)	-0.042 (0.035)
Online x environmental sciences and technologies	0.043* (0.026)	0.042* (0.026)
Online x biological sciences	0.059*** (0.007)	0.057*** (0.007)
Online x business and management	0.004 (0.004)	0.003 (0.004)
Online x media and communications	-0.051*** (0.007)	-0.052*** (0.007)
Online x information technology	0.018*** (0.005)	0.015*** (0.005)
Online x Education	-0.026*** (0.005)	-0.025*** (0.005)
Online x engineering and industrial technologies	-0.057*** (0.016)	-0.059*** (0.016)
Online x fine and applied arts	-0.024*** (0.004)	-0.028*** (0.004)
Online x foreign language	-0.021** (0.009)	-0.022** (0.009)
Online x health	0.067*** (0.008)	0.057*** (0.008)
Online x family and consumer sciences	-0.026*** (0.005)	-0.027*** (0.005)
Online x law	0.027 (0.026)	0.020 (0.026)
Online x humanities (letters)	-0.024*** (0.003)	-0.024*** (0.003)
Online x library science	0.070*** (0.013)	0.067*** (0.013)
Online x mathematics	0.001 (0.004)	0.003 (0.006)
Online x military studies	-0.037 (0.263)	-0.018 (0.264)
Online x physical sciences	0.063*** (0.007)	0.060*** (0.007)
Online x psychology	-0.004 (0.004)	-0.004 (0.004)

	(1)	(2)
Online x public and protective services	-0.060*** (0.007)	-0.055*** (0.007)
Online x commercial services	-0.097** (0.042)	-0.102** (0.041)
Online x interdisciplinary studies	0.001 (0.006)	-0.001 (0.006)
Constant	0.614*** (0.009)	0.619*** (0.009)
Observations	1,773,117	1,773,117
R-squared	0.310	0.311

NOTES: Social sciences is the reference group for the online x subject area interactions. In column 1, we are controlling for the overall effect of student characteristics on student success. In column 2, we are controlling not only for the overall effects of students characteristics but also for how those characteristics may have affected differences between online and face-to-face performance. Standard errors clustered at the student level are shown in parentheses. Both columns include term, college, and subject fixed effects. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

TABLE B12
Regression estimates for the likelihood of long-term student success

	Likelihood of earning an associate's degree	Likelihood of transferring to a four-year institution	Likelihood of earning a Chancellor's Office–Approved Certificate	Likelihood of any of the above
Share of earned units taken online	0.001 (0.001)	0.006 (0.001)***	-0.009 (0.006)	0.005 (0.001)***
Between 12 and 30 units completed*share online	0.002 (0.001)	-0.001 (0.001)	0.002 (0.007)	-0.001 (0.001)*
Between 30 and 60 units completed*share online	-0.007 (0.002)***	-0.006 (0.001)***	0.009 (0.007)	-0.008 (0.001)***
At least 60 units completed*share online	0.007 (0.001)***	0.005 (0.001)***	0.012 (0.007)*	0.010 (0.001)***
Full-time status	0.347 (0.014)***	0.626 (0.012)***	0.765 (0.060)***	0.729 (0.012)***
Number of terms enrolled	0.115 (0.002)***	-0.026 (0.001)***	0.143 (0.007)***	0.033 (0.001)***
Earned units as a share of attempted units	0.028 (0.000)***	0.010 (0.000)***	0.018 (0.001)***	0.012 (0.000)***
GPA	0.322 (0.013)***	0.214 (0.008)***	0.257 (0.044)***	0.246 (0.008)***
Dual enrollment	0.063 (0.016)***	0.153 (0.012)***	-0.064 (0.090)	0.146 (0.012)***
Academic disadvantaged status	0.016 (0.014)	-0.241 (0.011)***	-0.037 (0.065)	-0.223 (0.011)***
Enrolled in more than one college	-0.061 (0.017)***	0.078 (0.013)***	-0.086 (0.081)	0.059 (0.012)***

	Likelihood of earning an associate's degree	Likelihood of transferring to a four-year institution	Likelihood of earning a Chancellor's Office–Approved Certificate	Likelihood of any of the above
Ever enrolled in a basic skills course	–0.072 (0.015)***	–0.187 (0.011)***	–0.242 (0.063)***	–0.209 (0.010)***
Behavioral intent to transfer	0.613 (0.016)***	0.547 (0.011)***	–0.705 (0.071)***	0.470 (0.010)***
Less than high school	–0.146 (0.041)***	–0.368 (0.031)***	–0.024 (0.102)	–0.377 (0.026)***
College degree	0.508 (0.035)***	0.383 (0.029)***	0.055 (0.082)	0.548 (0.025)***
Unknown education	0.045 (0.027)*	0.017 (0.022)	–0.127 (0.096)	0.019 (0.020)
Disability status	0.115 (0.023)***	–0.133 (0.020)***	–0.014 (0.081)	–0.112 (0.017)***
College-age student	–0.060 (0.020)***	0.280 (0.016)***	0.013 (0.054)	0.201 (0.013)***
Female	0.188 (0.011)***	0.030 (0.009)***	0.095 (0.049)*	0.088 (0.008)***
Unknown gender	0.113 (0.098)	–0.108 (0.077)	0.217 (0.282)	–0.094 (0.071)
Latino	0.048 (0.014)***	–0.047 (0.011)***	–0.109 (0.057)*	–0.074 (0.011)***
Asian	–0.083 (0.018)***	0.124 (0.014)***	–0.067 (0.081)	0.059 (0.013)***
African American	0.146 (0.024)***	0.219 (0.018)***	–0.007 (0.099)	0.186 (0.017)***
Other race	–0.084 (0.046)*	–0.163 (0.036)***	–0.148 (0.175)	–0.172 (0.033)***
Unknown race	–0.022 (0.028)	0.091 (0.022)***	0.064 (0.105)	0.071 (0.021)***
Foreign born	–0.148 (0.020)***	–0.175 (0.016)***	–0.050 (0.080)	–0.182 (0.015)***
Unknown citizenship status	–0.073 (0.114)	–0.132 (0.092)	–0.383 (0.313)	–0.202 (0.079)**
Economically disadvantaged status	0.053 (0.014)***	–0.123 (0.010)***	0.263 (0.059)***	–0.091 (0.010)***
Other financial aid	0.121 (0.014)***	0.110 (0.012)***	0.093 (0.069)	0.102 (0.011)***
Observations	104,808	111,161	7,322	130,235

NOTES: Long-term success equals 1 if the student earned an associate degree, or a Chancellor's Office–Approved Certificate, or transferred to a four-year institution. The table shows estimated coefficients from probit models, no marginal effects. All models also include college dummies. Robust standard errors are in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

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